Evaluation of the Phoenix Crime Gun Intelligence Center

Final Report

National Crime Gun Intelligence Center Initiative

Bureau of Justice Assistance

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Executive Summary

In 2017, the Phoenix (AZ) Police Department was awarded BJA funding for establishing the Phoenix Crime Gun Intelligence Center (CGIC). The CGIC was a collaborative partnership of law enforcement agencies and experts including the Department's Crime Gun Intelligence Unit (CGIU), the Police Crime Laboratory, the Maricopa County Attorney's Office, the ATF's Phoenix Field Division, and Arizona State University's Center for Violence Prevention and Community Safety. The new CGIC, implemented in October 2017, committed to building and prosecuting intelligence-driven investigations that could "prevent gun violence through the consistent production of timely, precise and actionable intelligence concerning gun crimes to identify armed violent offenders for investigation and targeted enforcement."

For evaluation purposes, the inherent mission and characteristics of the CGIC presented a challenge. The Center was implemented across the entirety of the city of Phoenix, which ruled out the use of a randomized control design. Instead, to assess the extent to which the CGIC's proposed process was executed as planned and its consequent impact on NIBIN-related case investigations and offender prosecutions, we elected to examine change and to measure differences that occurred across our pretest/posttest study periods: October 2016-September 2017 (pretest, the year immediately preceding the CGIC), October 2017-September 2018 (posttest, 1st year) and October 2018-September 2019 (posttest, 2nd year).

Accordingly, the evaluation team documented and analyzed the CGIC's implementation processes and intervention strategies and measured impacts, relying on three sources of official police data (i.e., RMS, impounded evidence, NIBIN), ATF eTrace data provided by the PPD, Maricopa County Attorney's Office records, and the collective responses to our survey of point-of-contact investigators who coordinated the investigations of incidents linked through NIBIN leads. Overall, we found the CGIC's processes, as determined by its written policies and procedures, to have been consistently carried out as planned, and their impacts for the most part to be as expected or trending in a positive direction. In summary, findings of interest include the following:

- *The CGIC was associated with increased ballistic evidence collection.* Officers were trained in evidence collection strategies, techniques and report writing, and they were receiving feedback when evidence they had recovered produced leads. Consequently, posttest, they were responding to substantially more incidents where ballistic evidence was being found, where they were collecting increasing amounts of NIBIN-eligible ballistic evidence and recovering more guns.

- *The CGIC was associated with increased NIBIN entries and NIBIN leads.* The greater amount of evidence collected led to increases in the number of NIBIN entries, which in turn led to an increasing number of leads. During the year prior to the CGIC, PPD generated 175 leads, compared to 244 in the CGIC's first year and 461 in its second year. These findings indicate that PPD's comprehensive approach to ballistic evidence collection resulted in more effective intelligence gathering, in turn resulting in the identification of a greater number of gun crimes that were linked to at least one other gun crime.
- *The CGIC was associated with the expedited entry of ballistic evidence.* Analysis of official and survey data indicated that, posttest, the time between an incident and NIBIN entry of its related ballistic evidence had been reduced; pretest, the average time interval was 127 days; posttest (2nd year), this average dropped to 27 days. Pretest, about 3% of NIBIN entries were made within two days of an incident; posttest (2nd year), 32% of NIBIN entries met this standard.
- *The CGIC was associated with investigators perceiving leads to be more helpful (than leads received before the CGIC) in their investigations.* According to their survey responses, investigators found posttest NIBIN leads more likely to help with identifying a specific group or at least one person as suspects, interrogating suspects, arresting suspects, and case processing (i.e., charging, convicting, and sentencing). The CGIC's policies enabled the investigators to receive lead information more quickly, and timeliness was positively and significantly related to their finding the leads helpful.
- *The CGIC was associated with higher clearance rates***.** Difference-in-difference estimates using police data showed the CGIC's implementation to be related to increases in clearance rates. Change was most pronounced for offenses such as homicide, aggravated assault, and discharging a firearm. Higher clearance rates produced by the CGIC is a meaningful outcome, especially given the violent nature of the offenses.
- *The CGIC was not associated with a positive change in prosecutorial outcomes.* The CGIC, employing the County Attorney's vertical prosecution strategy, did not immediately produce a higher proportion of arrests being charged or higher conviction rates. Evaluation results were limited, however, by the current study's duration; the posttest period ended after only two years. A number of cases opened during the study period remained open as the study ended; their dispositions were not yet known, and they could not be included in our analyses.
- *The use of e-Trace did not improve with the CGIC's implementation.* The CGIC did not strongly promote eTrace, and the percentage of recovered firearms traced declined from pretest to posttest year one; however, the percentage of

recovered firearms traced to a purchaser increased in posttest years one and two, to 78% and 84%, respectively.

- *A pilot test of PPD's acoustic gunshot detection system (FireFly) demonstrated its potential effectiveness.* FireFly captured a majority of the gunshots in the study area; its effective range may be even larger than expected. The pilot test was limited by the number of communities examined, the onset of COVID and associated community changes, and the small number of shots fired-related crime incidents in the targeted area; however, our findings indicate several positive outcomes: Officers were more likely to respond to gunshots and they responded more quickly; incident reports were more likely to be filed; in the study area, more casings were impounded and arrests increased (compared to one of two control areas and all remaining areas in the jurisdiction).

The Phoenix Police Department has made exceptional progress towards institutionalizing a robust multi-agency response to gun crime, both with its historical efforts to maximize the use of the NIBIN network and its more recent establishment of a highly functional, productive CGIC in a relatively short time. Their accomplishments in the Center's first two years have provided a strong foundation for their next steps towards realizing the CGIC's full potential.

Introduction

The Phoenix Crime Gun Intelligence Center (CGIC) is one of 19 such centers in the United States (BJA, 2020) which serve as interagency collaboratives that collect, analyze and distribute intelligence data related to crime guns, mass shootings and other major incidents across multiple jurisdictions. The CGICs provide investigative leads and support for crime gun intelligence initiatives across the United States and beyond.[1] The concept originated in 2013 when the National Institute of Justice (NIJ) sponsored an evaluation of the National Integrated Ballistic Information Network (NIBIN), a program administered by NIJ's Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) (King et al., 2013). King and colleagues conducted site visits at ten US law enforcement agencies that had incorporated NIBIN as an investigative tool for compiling and attempting to match ballistic evidence from different crime scenes. At each CGIC site, the evaluation team examined data from investigators, crime labs and NIBIN lead files.[2] Evaluators found substantial variability in NIBIN implementation across the ten sites, and they found that NIBIN intelligence reports, meant to inform and advance investigations, were rarely reaching investigators in time to be useful.

While finding room for improvement in the execution of NIBIN, the evaluation team stressed the system's potential value to law enforcement agencies as a source of tactically and strategically beneficial intelligence, and they concluded by recommending that the ATF provide resources for establishing NIBIN Centers of Excellence to serve as exemplars in the response to gun crimes. These Centers could demonstrate a more comprehensive implementation of effective organizational structures and operational strategies centered on the NIBIN network and serve as learning laboratories where policymakers and practitioners could “learn first-hand how to establish effective structures, policies and practices for leveraging the power of NIBIN” (King et al., 2013, p. 92). In 2013, the ATF funded CGICs in Denver, Milwaukee and Chicago.

The CGIC model calls for agencies and the ATF to collaborate in the timely collection, management and analysis of crime gun evidence generated by NIBIN and eTrace, an electronic firearm tracing system, along with other innovative technologies. These systems are capable of rapidly generating leads linking evidence and crimes that investigators might not otherwise be able to recognize as connected and identifying

[1] See https://www.atf.gov/resource-center/fact-sheet/fact-sheet-crime-gun-intelligence-centers-cgic

[2] "A NIBIN lead is an unconfirmed, potential association between two or more pieces of firearm ballistic evidence and is based on a correlation review of the digital images in the NIBIN database. When needed for court or other purposes, a firearms examiner will conduct a microscopic examination of the actual physical evidence to confirm a NIBIN lead as a hit. A NIBIN hit occurs when two or more firearms ballistic evidence acquisitions are identified as a confirmed match by a firearms examiner. The data is then compiled into intelligence reports that are used for investigations and court cases." See https://www.atf.gov/resource-center/fact-sheet/fact-sheet-national-integrated-ballistic-information-network

guns and firearms traffickers that are disproportionately responsible for gun crimes (Police Executive Researcher Forum, 2017). Although CGICs may vary somewhat from location to location, the model is structured around five fundamental principles (Police Foundation, n.d.):

1. Regardless of the type and severity of a crime, all shell casings and guns at its site are immediately collected and treated as evidence.
2. Timely processing of NIBIN and eTrace evidence is critical; within the first 24-48 hours of collection, shell casing data are entered in the NIBIN network and guns are traced through eTrace.
3. Across offense types and police districts, dedicated teams coordinate the investigations of linked crimes that are found to have been committed with the same gun.
4. Forensic technology is leveraged to investigate and prosecute crimes, as NIBIN, eTrace, gunshot detection systems and other technologies are used to focus resources on offenders who use guns.
5. Police establish and maintain partnerships among investigative units, federal law enforcement agencies and the courts who then direct interagency resources toward high-priority violent offenders.

Three prior evaluations of CGICs have been conducted, reporting mixed results.

Milwaukee Police Department (MPD). Koper and colleagues' (2019) examination of the impact of the MPD's CGIC on its investigations found that clearance rates for homicide, nonfatal shootings, and shots fired had declined over the study period (2014-2017). Specifically, from the CGIC's first to its fourth year, clearance rates for NIBIN-related nonfatal shootings increased from 27% to 42%, although no changes were found in clearance rates for homicide and shots fired incidents. They also noted the possibility that MPD's deployment of a new gunshot detection system may have contributed to their outcome. The authors concluded that the CGIC was of "high strategic value" to Milwaukee (p. 48), especially with respect to increasing the investigation capacity of the police for clearing incidents involving nonfatal shootings.

Los Angeles Police Department (LAPD). The Los Angeles CGIC included four LAPD divisions: 77th Street, Harbor, Southeast and Southwest. Evaluators found that after the CGIC was established, LAPD increased its collection of firearms crime evidence, its use of interdepartmental collaborations for investigating gun crime, and its use of actionable intelligence (Uchida et al., 2019). The CGIC's impact on firearm-related crime was mixed: The 77th Street Division's gun-related homicide rate declined almost 8% and firearm-related robberies declined about 3%. In the other three divisions, however, rates of gun-related homicide, robberies and aggravated assaults had not changed.

Metropolitan Police Department, WA DC. The Office of the City Administrator evaluated the MPD's CGIC and concluded that it had had no statistically significant impact on violent crime, calls for service for gunshots or arrest rates; this evaluation was troubled, however, by a number of methodological and data limitations (The LAB @ DC, 2019).

The Present Study

In 2017, the Phoenix Police Department (PPD) was awarded a grant by the Bureau of Justice Assistance (BJA), a branch of the Department of Justice (DOJ), Office of Justice Programs (OJP), for the purpose of establishing the Phoenix Crime Gun Intelligence Center. The Center's purpose was to collect, manage and analyze crime gun intelligence and to improve firearms-related investigative efforts and prosecutorial outcomes in Phoenix. This report details the implementation and operation of the Phoenix CGIC and presents findings and outcomes from the process and impact evaluations conducted by the research partner, the Center for Violence Prevention and Community Safety, Arizona State University (CVPCS).

First, we describe the project setting, Phoenix, Arizona, and its gun crime problem. We then outline the PPD's earlier history as an official NIBIN site and its path toward becoming a CGIC. Next, we describe the evaluation design employed, including both process and impact evaluations. This is followed by a discussion of the implementation of the CGIC, including its organizational structure, staffing, partnerships and operations. We present our process findings (i.e., the CGIC's activities, evidence processing using NIBIN and eTrace, and assignment of NIBIN lead investigations) and our impact findings, specifically the perceived and measured impacts of the CGIC and lead notifications on investigations, clearance rates, and prosecutorial outcomes; we also review the impact of the CGIC's gunshot detection system on evidence acquisition. Finally, we summarize these findings and present recommendations for further action.

Project setting

The City of Phoenix, capital of the state of Arizona, is the largest city in the state and the fifth largest city in the US. It has a landmass of 516.7 square miles and a population of about 1.7 million.[3] Bordered by the cities of Glendale, Scottsdale, Avondale, Peoria, Paradise Valley, Cave Creek, Tolleson, Chandler and Tempe, Phoenix is located in the center of a metropolitan area comprised of more than 4.8 million people (exhibit 1). The city's population has been increasing by about 25,000 residents a year, according to a current census estimate, making it one of the fastest growing cities in the US. The population is largely comprised of White (43.3%), Hispanic (42.5%) and African American (6.9%) residents. About 20% of its residents are foreign born, with 37.3% speaking a language other than English at home. The median income

[3] Data received from https://www.census.gov/quickfacts/phoenixcityarizona for 2019.

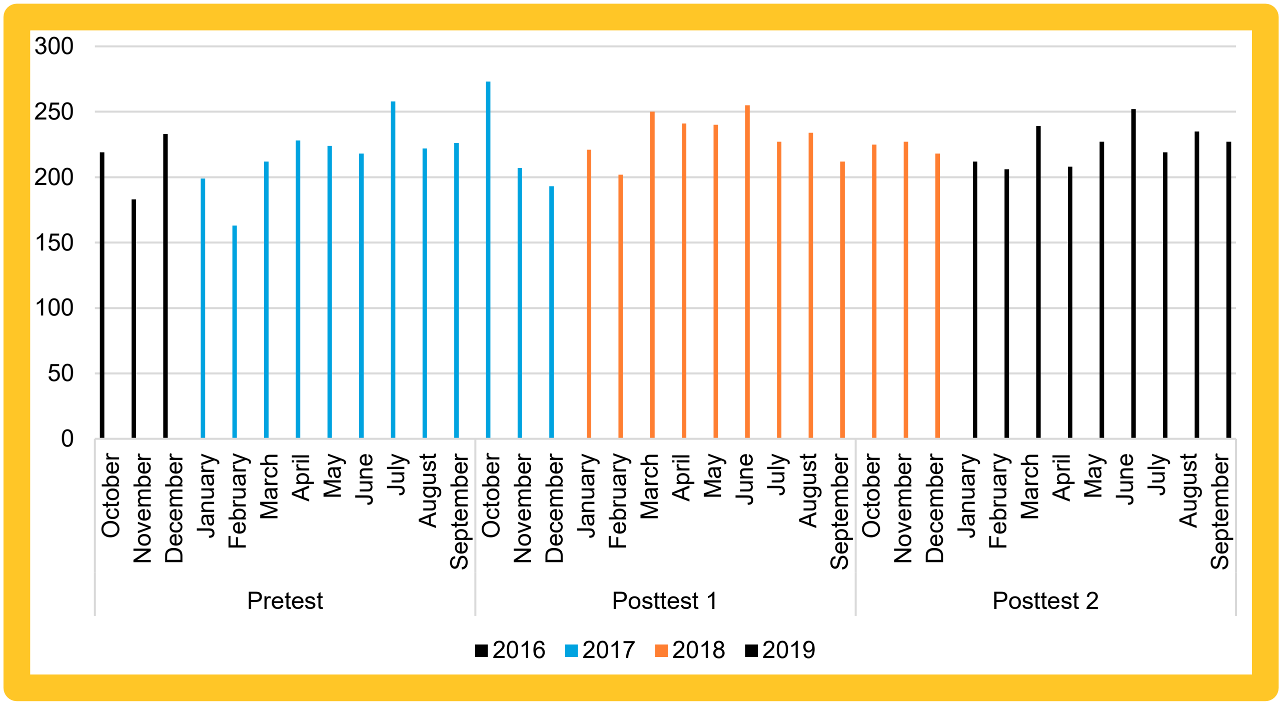
is about $52,000/year; about 21% of its residents live below the poverty line.

The PPD is the ninth largest municipal police department in the US. Having grown by roughly 15% over the past 18 years, the Department is staffed with about 2,900 sworn officers and more than 1,000 civilian personnel. Phoenix crime rates have remained fairly stable for several years. In 2018, approximately 43.5 index crimes per 1,000 residents were reported to the PPD. The violent crime rate was 7.5 per 1,000 residents, and the property index crime rate was 36 per 1,000 residents.[4] (This compares to 2018 national average rates of about 37 per 1,000 for violent crime and about 22 per 1,000 for property crime.)[5] From 2016 through 2019, PPD official crime data show that gun offenses were stable.[6] Exhibit 2 shows the number of reported gun offenses by month for this report's study period, October 2016 through September 2019.[7]

Exhibit 1. Map of Arizona and Phoenix metropolitan area

[4] Data from included UCR Phoenix Crime Statistics.
[5] Data from most recent full year of data, 2018. Report available from UCR.FBI.gov
[6] Data received from attached Crime Analysis and Research Unit report. Explosives numbers were removed from report to clarify data.
[7] Data from incident reports from the study period included only incident reports for which the keywords *firearm*, *discharge*, *discharging*, *shooting* or *gun* were mentioned in associated offense codes.

Exhibit 2. Phoenix, Arizona: Gun-related offenses, by month (pretest/posttest)



Crime Gun Intelligence Prior to the Phoenix CGIC

In 2002, Phoenix became an official NIBIN site when a forensic technology system (i.e., a Heritage Brasscatcher NIBIN terminal) was installed in the PPD's Laboratory Services Bureau, Firearms Section. From the outset, the NIBIN program suffered a lack of resources, and the number of NIBIN entries of bullet casing evidence remained low. In 2005, the PPD formed two new units, the Gun Squad, which assumed responsibility for investigating weapons offenses, and the NIBIN Squad, which assumed NIBIN administrative responsibilities. Together, the two squads operated with ten investigators. The Gun Squad officers were trained in the acquisition of bullet casings from crime scenes and the performance of correlation reviews and then were given access to the Lab's NIBIN terminal. Potential NIBIN leads (i.e., matches between one or more bullet casing entries in the NIBIN system) identified by these officers, as opposed to Lab technicians, were initially called *preliminary* NIBIN hits. The preliminary hits were then sent to the Lab, where firearms examiners would review the actual ballistic evidence and either confirm or deny each NIBIN hit. Once a match was Lab-confirmed, connecting two or more incidents where the same gun had been used, the Gun Squad could issue a NIBIN hit report notifying investigator(s) assigned to the related incidents of the finding.

In 2008, the Lab relocated across the street from police headquarters, acquired another NIBIN terminal, and upgraded its technology to BrassTrax. The Lab's processing capacity continued to be limited, however, impeding timely NIBIN hit confirmations; it often took months or even years for hit notifications to reach investigators. The vast majority of cases with NIBIN hits awaiting confirmation were closed long before the evidence was processed, and linked incidents by then were rarely, if ever, followed up and investigated.

Four years after creating the NIBIN and Gun Squads, in 2009 the PPD merged the two, forming the single Gun Enforcement and NIBIN Squad. This unit was led by a sergeant and staffed with seven investigators and two police assistants. It was charged with investigating prohibited possessors of weapons, possessors of prohibited weapons, Shannon's law violations, gun store burglaries, and carrying concealed weapons, and it administered the NIBIN program (City of Phoenix, 2012). The ATF contributed two civilian contractors to assist with NIBIN and eTrace processing.

When the Lab was relocated in 2008, its original NIBIN terminal had been left behind at police headquarters, where the trained Gun Squad investigators continued to enter ballistic evidence. Over time, this terminal was upgraded with BrassTrax, and a third Brasstrax NIBIN terminal was acquired. Civilian personnel were hired to accelerate the pace of evidence processing. Contrary to practice in most other NIBIN sites, by now NIBIN processing was nearly all being conducted by sworn and civilian personnel who operated independently from the Lab. Some began referring to this as the "outside-the-lab approach."

Still more was needed to fully address the persistent timeliness problem, however. Ultimately, the PPD approved a new practice and began notifying investigators immediately when preliminary NIBIN matches were found, prior to their being Lab-confirmed. To distinguish them, unconfirmed potential matches were called NIBIN *leads*, while confirmed leads were called NIBIN *hits*. This change finally allowed investigators to be notified when their cases appeared to be linked with one or more others much earlier in the investigative process. Whenever a further evaluation became necessary to establish its scientific validity, particularly for court cases, the NIBIN lead would be sent to the Lab for official confirmation. This practice was considered to be highly innovative at the time.

Maintaining the Phoenix NIBIN terminals outside the official lab environment soon fostered another important innovation. The NIBIN database grew as the PPD invited nearby law enforcement agencies to participate in the evidence-gathering process. The PPD began training other agencies' personnel to enter evidence in the PPD's NIBIN system and hosted monthly "shoots" where other law enforcement agencies could test fire firearms and enter the evidence directly into the NIBIN terminal. In June 2010, recognizing that crime in one area often crosses into neighboring jurisdictions, the PPD officially launched the Phoenix Metro NIBIN Program.

The Department's collaborative approach eased the initiation of other agencies into the system and was successful in increasing their participation; by 2013, more than thirteen other agencies, including the Border Patrol, were participants in the NIBIN program. At the time, such partnerships were a rarity among NIBIN sites. Until at least 2013, the PPD maintained a highly productive NIBIN site. There was a noteworthy increase in NIBIN entries; from 2009 to 2010, the number increased from 4,200 to 6,400. By 2010, the PPD could claim more NIBIN entries than any other US NIBIN site (Rocky Mountain Information Network Bulletin, March 2011). Between October 2007 and July 2012, Phoenix logged 30,405 acquisitions, placing the city in the 93.7th percentile among all operational NIBIN sites. Also, having confirmed 262 hits of projectiles, casings and brass, Phoenix placed in the 83.4th percentile in this category (King et al. 2013, table 16, p. 55).

Despite these real successes, however, the rate at which acquisitions were being processed continued to lag behind that needed to support the PPD's active investigations. During the period from 2007 to 2011, when 19 other high-performing NIBIN sites were averaging 101 days between first and second crimes having been linked by a NIBIN lead, the majority of the PPD's evidence continued to be entered in the network months, and still often a year or more, after it had been collected. During this period, the PPD identified 336 NIBIN hits, but the median number of days between the related NIBIN entries producing those hits was 416.5, or over a year.

In 2014, for a variety of reasons, the Squad was downsized, the entire staff now consisting of a sergeant, four investigators, one police assistant, and a secretary. Three of the investigators remained responsible for handling firearms-related cases, while another investigator and the civilian staff managed the NIBIN program. Then early in 2016, in the wake of department-wide staffing shortages, the Squad was again split into two units. The former sergeant retired and the three investigators working firearms-related cases moved to the Gangs Unit, working under new supervision. The NIBIN Squad was reduced to the remaining investigator, police assistant and secretary, all now supervised by a Bureau administrative sergeant. The ATF continued providing two civilian contractors to assist, albeit in a more limited capacity. With such a diminished staff, the NIBIN program was capable of processing only a very limited amount of evidence, nearly always generating lead reports at or after the conclusion of a case. NIBIN leads were still sent to investigators in other parts of the Department, but a NIBIN investigator was no longer a participant in their investigations and there was no one to follow up linked incidents.

In early 2018, the BJA grant that would eventually fund the new CGIC became a possibility. The three investigators who had been reassigned to the Gangs Unit in 2016 returned to the NIBIN Squad, and a new position was created for a supervisory sergeant. The NIBIN Squad transitioned into the Crime Gun Intelligence Unit (CGIU), which remains in place as of this report. Another four investigators were brought in, and by the end of 2018, the CGIU had also acquired a second sergeant, a crime analyst, and another four police assistants. PPD appeared well-prepared to implement the new Crime Guns Intelligence Center (CGIC), a collaborative of area agencies responsible for resolving gun crimes from investigation through prosecution, and the grant was approved.

Evaluation design

The Phoenix CGIC was implemented across the entirety of the City of Phoenix, ruling out the use of a randomized control design. Instead, the evaluation team chose to examine pretest and posttest differences that occurred over the study period. The pretest period consisted of the 12 months immediately prior to the initiation of the CGIC (October 2016-September 2017). We then assigned two posttest periods: period one, the CGIC's first full year of operation (October 2017-September 2018) and period two, the CGIC's second full year of operation (October 2018-September 2019).

The evaluation team assessed both processes and impacts. A *process* evaluation reviews and assesses the content and dosage of an organization's activities and interventions. Accordingly, we documented and analyzed the CGIC's implementation processes and intervention strategies, in order to determine the extent to which they were carried out consistently and according to plan. Otherwise, it would not be possible to determine with certainty whether outcomes were attributable to the intervention. Our measures included, for example, the number of PPD incidents where guns and ballistics evidence were recovered, the number of guns collected, the volume of evidence available for NIBIN entry and of evidence actually entered, and the time elapsing between crime dyads (i.e., two crimes connected by a common gun or ballistic evidence) and their respective NIBIN entries. We also measured the number of NIBIN leads and linked incidents, the number of recovered guns that were traced through the ATF, the average time taken to trace guns, and the number of NIBIN leads assigned and managed by a CGIC investigator.

An *impact* evaluation is conducted to learn whether activities carried out culminated in the desired changes and outcomes. The initial expectation was that implementing the CGIC's new or revised outcome-oriented policies and processes would result in faster NIBIN entries, an increased volume of NIBIN entries, and an increased number of NIBIN leads. Further, it was expected that these changes would result in increases in gun crime clearance rates and the number of charges filed and convictions. It was also expected that the more recent deployment of the FireFly gunshot detection system would result in greater numbers of shots-fired incidents being responded to, incident reports being filed, and casings and firearms being recovered. Finally, it was expected that response times would decrease and a greater proportion of incidents would result in arrests, charges, and ultimately convictions.

Our process and impact evaluations relied on six separate data sets. The PPD made available four sources of official data, and the Maricopa County Attorney's Office (MCAO) provided a fifth source. The sixth data source was comprised of the collective responses to our survey of investigators of incidents involving NIBIN leads. The following data were collected and analyzed for the study period, October 2016 through September 2019:

1. PPD's Records Management System (RMS) data, including information related to calls for service, FireFly activations, Computer Aided Dispatch (CAD) detail reports, incident reports and arrests;
2. PPD's database of impounded evidence, providing the number of crime scenes that resulted in the recovery of guns and ballistic evidence;
3. PPD's NIBIN lead data, including information about evidence eligible for NIBIN entry, whether or not that evidence had been entered, time elapsing between an incident and NIBIN entry, and the number of leads produced;
4. PPD-provided ATF eTrace data, including information about numbers of guns traced, those traced to a purchaser, and those traced to a Federal Firearms Licensee Number;
5. MCAO data pertaining to cases charged and cases resulting in convictions;
6. Data resulting from our analysis of survey responses from investigators who, during the study period, coordinated linked investigations of incidents with NIBIN leads, including homicide, aggravated assault, aggravated robbery, armed home invasion, armed robbery, assault involving a gun, attempted homicide, attempted murder, discharge of a firearm, domestic violence, drive-by shooting, felon/prohibited possessor in possession of a firearm, home invasion, kidnapping, murder, robbery, robbery/aggravated assault, or shooting at a dwelling.

The investigator surveys were designed to collect details about investigations with NIBIN leads, focusing on the role of those leads and the ballistic evidence. For the pretest period, 145 surveys were administered to coordinating investigators who served as points of contact for linked NIBIN-related cases; 105 surveys were returned (response rate 72%). For posttest period one, 240 surveys were administered and 153 were returned (response rate 64%). For posttest period two, 352 surveys were administered and 218 were returned (response rate 62%).

Implementing the Phoenix Crime Gun Intelligence Center (CGIC)

In 2017, the PPD was awarded BJA funds to establish a Phoenix-based CGIC, where the PPD Crime Gun Intelligence Unit (CGIU) and its law enforcement partners would collaborate to develop and implement policies and practices for collecting, managing and analyzing crime gun data that could help to measurably reduce the area's number of gun-related crimes. The PPD and its partners committed to building and prosecuting intelligence-driven investigations that would fulfill the CGIC mission:

> …to prevent gun violence through the consistent production of timely, precise and actionable intelligence concerning gun crimes to identify armed violent offenders for investigation and targeted enforcement.[8]

Below, we describe the CGIC partnerships, staffing, roles and responsibilities, and operations in place during the posttest phase (October 2017-September 2019) of the study period (October 2016-September 2019).

CGIC partnerships, staffing and roles/responsibilities

The Phoenix-based CGIC is a collaborative partnership involving law enforcement agencies and experts, including the PPD CGIU, the Phoenix Police Crime Laboratory (Lab), the Maricopa County Attorney's Office (MCAO), the ATF's Phoenix Field Division, and Arizona State University's Center for Violence Prevention and Community Safety (CVPCS). Each partner has a specific, well-defined role and responsibilities under the CGIC umbrella; their representatives regularly communicate and collaborate to review the program's progress, make decisions, and support the program's overall success.

The PPD's CGIU, located in the Violent Crime Bureau (VCB), is the principle investigative partner. The Unit is under the administrative leadership of a lieutenant who is also responsible for the Assaults Unit (which houses the CGIU), the School Crimes Unit, and the Bias Investigations Unit. The CGIU is staffed with two sergeants, eight NIBIN/weapons investigators, six digital forensic evidence detectives (aka forensic examiners), five non-sworn police assistants, and a secretary, and a criminal intelligence analyst. The sergeants supervise the investigators, three of whom are assigned to weapons incidents *not* associated with a NIBIN lead. The five other investigators, all sworn ATF Task Force Officers, are assigned to incidents with NIBIN leads; they coordinate with ATF Field Office agents, who bring together stakeholders from related investigations and contribute investigative resources and expertise, additional staff resources, and eTrace processing.

The criminal intelligence analyst oversees the CGIU's NIBIN processing and generates additional intelligence, with mapping technologies and other resources that support the NIBIN lead investigations. The CGIU's police assistants are trained to properly swab evidence for DNA, test fire firearms, and enter evidence and test-fired cartridge data into the BrassTrax system. The Lab processes DNA and fingerprints related to investigations, reviews and confirms NIBIN hits, and certifies scientific

[8] As defined by the Bureau of Justice Assistance.

laboratory processes, the latter whenever certification is needed for court cases involving NIBIN leads that are being prosecuted by the County Attorney's Office. The CGIC research partner, the CVPCS, provides research assistance in support of program development and implementation, and conducts the formal program assessment and evaluation.

CGIC operations

The Phoenix Metro NIBIN Program—its placement within the PPD, policies and procedures, and staffing—fluctuated throughout its existence. Early in the planning for its successor, the BJA-funded CGIC, the Police Foundation, under the auspices of the National Resource and Technical Assistance Center for Improving Law Enforcement Investigations and with the support of the BJA, identified best practices already in place in the PPD's NIBIN-related operations. A gap analysis was conducted to identify opportunities for improvement, and the CGIU began to address the resulting recommendations. For purposes of this report, the six process steps below outline policies and practices put into place; these were in effect and appeared to be well institutionalized during the study period, October 2016 through September 2019.

Step 1. Comprehensive collection of shell casings and crime gun evidence

The CGIC adopted two new strategies for increasing the CGIU's comprehensive collection of shell casings and crime guns: (a) Train patrol officers in professional evidence collection techniques, and (b) deploy FireFly, a mobile acoustic gunshot detection technology that alerts officers to gunshots, whether or not reported by citizens, and pinpoints their locations.

Training in evidence collection techniques. The CGIU produced two 5-minute training videos demonstrating techniques for comprehensive ballistic evidence collection; all PPD sworn officers were required to view them. The videos emphasized the reasons for recovering all ballistic evidence from every incident regardless of its severity, the role of comprehensive collection in the CGIC's overall mission and strategies, and the measurable impact of comprehensive collection on crime solvability. The CGIU actively encouraged patrol officers to thoroughly canvass their crime scenes whenever feasible and taught them how to avoid evidence contamination by using individual vials for casings, not touching areas where fingerprints could be present, and changing gloves and using clean tools for handling different items. Officers also received training in report writing, including how to document details of where and how ballistic evidence had been recovered. Beyond the videos, in-person trainings discussed these issues in greater depth; 74 patrol officers had voluntarily attended. The effort to make training accessible and targeting performance expectations was aimed at increasing the number of shell casings and guns collected from incident sites and preserving the integrity of that evidence. Officers were directed whenever in doubt to reach out to the Violent Crimes Bureau for further guidance and clarification.

FireFly deployment. The CGIU had learned about a mobile acoustic gunshot detection technology (similar to ShotSpotter) that was being pilot-tested in Colorado. After investigating its effectiveness in Colorado Springs in 2018, and discussing the possibility of its fit in Phoenix with FireFly developers Hyperion Technology Group and the Invariant Corporation, the CGIU concluded that the technology had the potential to strengthen their program and that it would integrate well with technologies already in use. The CGIU deployed FireFly in 2019.

FireFly technology consists of a series of sensors with 360-degree microphone arrays capable of capturing the sound of any potential gunshot occurring within about a 400-meter radius. Strategically placing sensors throughout a small geographic area makes it possible to triangulate the location of a shot, based on the time each sensor is triggered. In Phoenix, the data are automatically relayed to the PPD dispatch center where they are reviewed for authenticity (i.e., the sound is a gunshot and not a backfire or other similar sound). When a FireFly gunshot alert is confirmed, dispatchers enter a call for service in the police CAD system, requesting that an officer respond to the location. FireFly's significant advantages are that firearms incidents investigated may no longer be limited to those reported by citizens, and incident locations may be more quickly and accurately pinpointed. The FireFly technology was expected to increase the number of gunshots investigated, reduce officer response times, and increase the amount of ballistic evidence and guns collected for NIBIN entry and eTrace.

Step 2: NIBIN entry/correlation and eTrace crime gun tracing

The gap analysis mentioned above had identified two key opportunities for enhancing NIBIN entry: (a) establishing a written policy designating the type of evidence to be processed with a clear timeframe for doing so, and (b) developing a process for expediting fingerprinting and preserving DNA for serious offenses, enabling NIBIN processing to achieve the 24/48-hour timeliness goal.

The CGIU, the PPD Crime Lab, and the County Attorney's Office collaborated to find a legally defensible and yet practical forensic middle ground between comprehensive laboratory analyses and expedited processing of firearms-related NIBIN evidence. Following its collection, the group decided, shell casings and crime gun evidence would be "triaged," that is, prioritized in accord with the incident's seriousness (i.e., by crime tier) and the unit responsible for its evidence collection. The result was an achievable and sustainable policy and set of practices that would enable the PPD to accomplish several objectives—to preserve the integrity of forensic evidence, meet the demand for expedited NIBIN entry, and provide prosecutors with the timely evidence needed to succeed in court. The specific procedures to be followed would be determined by how the incident was classified:

> *Tier 1 crimes* include firearms-related homicide, aggravated assault where death is imminent, officer-involved shootings, mass fatalities and

threats to public safety, and other designated high priority crimes involving the use of a firearm. On-scene investigators determine whether evidence will require crime lab processing or will be forwarded to the CGIU for expedited NIBIN entry. For example, if there was a pressing need to establish possession of a firearm, obtaining fingerprints would be the highest priority, and Crime Scene Response Section personnel or the case agent would transport firearm(s) directly to the Lab. After processing the firearm, the Lab would send it on to the CGIU for NIBIN entry. If prints were not needed, the firearm would be transported directly to the CGIU office, where textured areas of the firearm would be swabbed to preserve DNA and smooth areas would be protected for latent print development or additional DNA collection, all prior to NIBIN testing. The firearm would then be test fired using clean techniques, and a NIBIN entry for its exemplar would be made.

Tier 2 crimes include firearms-related aggravated assault, armed robbery, drive-by shootings, misconduct involving weapons, and similar crimes for which a firearm is used and injury is non-life-threatening or nonexistent. In these cases, the practice was for an onsite supervisor to request that the CGIU respond to the crime scene to advance the investigation with expedited firearms-related evidence processing. All eligible firearms evidence was processed by CGIU personnel, who determined the method to be used to process and test fire the firearms. Case agents could prioritize prints over immediate NIBIN processing only when an investigative supervisor had justified and approved the policy deviation. Whenever possession had not yet been established, the process remained similar to that for Tier 1 crimes. Alternatively, if possession had otherwise been established, the CGIU could forego swabbing and simply test fire the gun using clean techniques.

Tier 3 crimes are those involving forfeited firearms and firearms recovered from a pawnshop. CGIU personnel retrieved these firearms from the PPD Property Management Bureau and processed the evidence. These firearms are not typically eligible for laboratory testing; rather, the firearm would be test fired by police assistants wearing gloves and a mask, and an exemplar would be entered into NIBIN.

Only the CGIU's ATF-trained-and-certified officers were permitted access to NIBIN technologies such as BrassTrax and Matchpoint+. In a memorandum of understanding with PPD, the ATF stipulated that NIBIN systems were to be used only for imaging firearms-related evidence and test firing firearms that were illegally possessed or that had been used in a crime or were suspected of having been used in a crime. Eligible firearms included semiautomatic pistols (any caliber), revolvers (case by case), 12-gauge shotguns (and other calibers, case by case), .22 long rifles and rimfire chambered rifles, semiautomatic rifles (all AR-15, Mini-14, SKS, and AK-47 types), and any other firearm specifically requested by an ATF case agent.[9]

CGIC policy permitted both civilian and sworn personnel to make eTrace entries for firearms recovered by the PPD during the course of an investigation. The eTrace web-based system allows law enforcement agencies to submit trace requests to the ATF in order to discover a firearm's documented ownership history. ATF tracing center staff are able to manually trace the movement of a crime gun from the time of its manufacture or import into the US, through the distribution chain, until its first purchase by an individual, and they are permitted to provide the requesting law enforcement agency with the trace results. With the eTrace information, investigators often can determine (a) the original purchaser, (b) the owner(s) of lost or stolen firearms, (c) straw purchasers who are illegally providing firearms to individuals not legally allowed to purchase or possess them, (d) Federal Firearm Licensees engaging in illicit sales, (e) how, where, why and when legally possessed firearms are entering into illegal or criminal use, (f) the amount of time from purchase to use in criminal activity, and (g) high recovery areas.

Step 3: ATF crime gun intelligence analysis

NIBIN leads identified by the ATF's NIBIN National Correlation and Training Center (NNCTC) were sent to assigned ATF/CGIC Coordinators and ATF Industry Operations Intelligence (IOI) specialists who, in turn, would forward the information to Phoenix CGIU personnel. The IOI specialists support investigations by collecting incident reports from related agencies, providing feedback on possible follow-up strategies, preparing summaries of related cases determined through NIBIN leads (including link charts), and entering relevant data in the ATF's eTrace system.

Step 4: NIBIN lead assignment & investigation

The PPD assigned incidents without NIBIN leads to investigators by offense type. A subsequent NIBIN lead, suggesting a new preliminary ballistic link among multiple incidents, would trigger the creation of a new NIBIN case, comprised of two or more linked incidents, which would then be entered in the PPD records management system (RMS). The new composite case was assigned to a CGIU coordinating investigator who would assume responsibility for facilitating a cooperative effort to resolve not just the first identified incident, but all of its associated ones. This investigator would contact those responsible for each of the linked incidents, regardless of unit, alerting them to

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[9] CGIU personnel typically do not process or test fire large caliber hunting rifles, black powder rifles and handguns, pellet guns, antique and rare caliber firearms (unless requested by a case agent), revolvers, shotguns (excluding 12-gauge), safekeeping guns, guns not suspected of having been used in a crime, and department-issued firearms. Instead, representative samples of each of these firearm types are selected and prepared for NIBIN entry. Certified CGIU and National NIBIN Correlation and Training Center personnel may complete and review these correlations.

begin working the lead cooperatively. The coordinating investigator ensured that evidence- and intelligence-sharing communication occurred such that the entire set of lead-related incidents might be resolved. Once one suspect had been identified, located and apprehended, the ballistic evidence often could be leveraged during interviews by the other investigators, helping to clear their respective cases.

Step 5: County prosecution of CGIC cases

The Maricopa County Attorney's Office (MCAO) was the designated coordinator for NIBIN-related prosecutions, with only a few exceptions. A full-time prosecuting attorney was assigned to manage the vertical prosecution strategy employed for these cases. The attorney would consult with CGIC partners on matters such as search and arrest warrants, case viability, and the MCAO policies pertaining to the law. In contrast to the common prosecutory practice of handing off cases to different attorneys for successive stages of prosecution, the vertical strategy allows a single prosecutor to handle all aspects of NIBIN-related cases, including all of their associated incidents, from arrest through conviction.

The coordinating county prosecuting attorney oversees about 15 case prosecutors and one crime analyst, all of whom are trained to conduct vertical prosecutions. In addition, he or she attends initial appearances to present all of the linked incidents to the presiding judge, speaking to the suspects' potential for violent escalation and thus affecting decisions on bond qualifications and amounts, as well as on enhanced sentencing opportunities. The prosecutor's early involvement in each case ensures greater familiarity with its specifics, resulting in a more complete and effective court presentation of each suspect's risk to the public.[10]

Step 6: CGIC feedback to process participants

The CGIC acknowledged that program excellence would depend on motivated actors at all levels who could maintain their commitment to executing their responsibilities effectively, day after day. One group's performance in particular had often been taken for granted, and so a sixth process step was incorporated, that is, routinely notifying and recognizing patrol officers whenever casings or firearms they had collected onsite were linked in the NIBIN network. The importance of the patrol officers' role was promoted in training, where it was emphasized how collecting and processing quality evidence from the field would facilitate its conversion into quality intelligence, but the CGIC wanted to ensure that officers' on-the-job experience would reinforce this message. Specifically, whenever evidence has been collected by a patrol officer and linked through NIBIN, the ATF/IOI specialist responsible for notifying the CGIU also notifies all impounding officers that their good work has resulted in fresh NIBIN-related intelligence and thanks them for their diligence. The CGIC's aim is for patrol officers to

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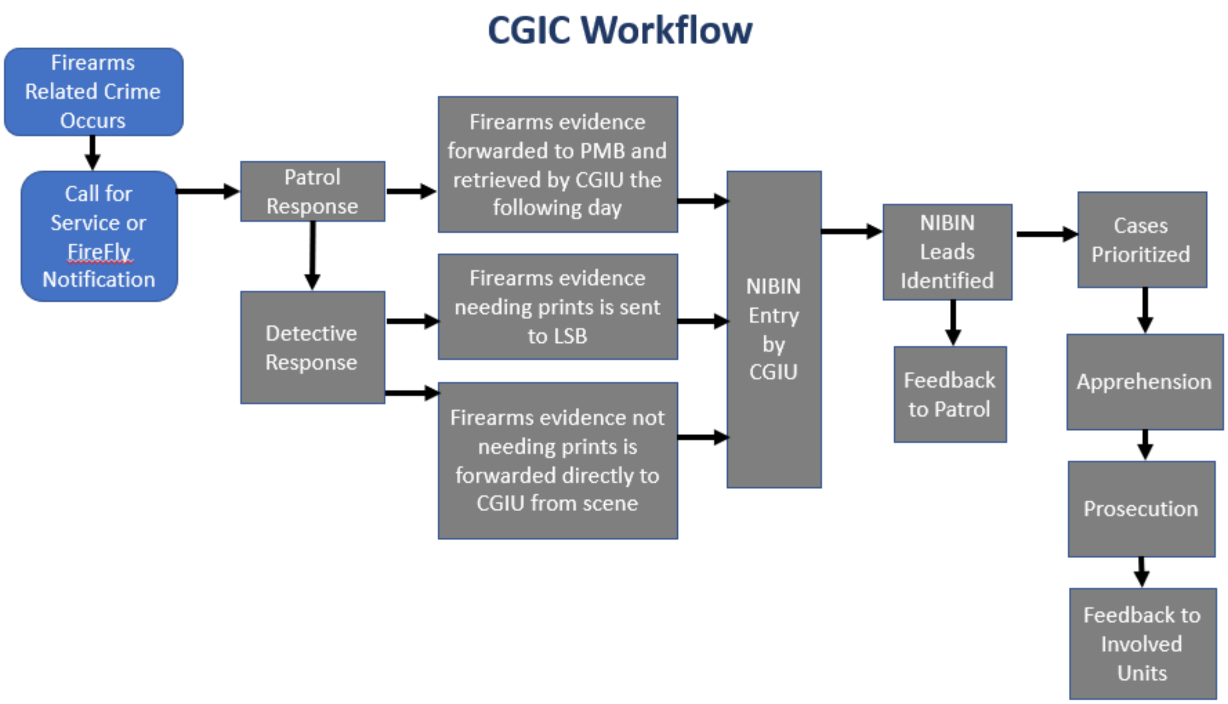
[10] In 2019 (after the study period), the MCAO was awarded $300,000 by to BJA to enhance its NIBIN-related prosecution efforts. See https://www.maricopacountyattorney.org/364/MCAO-and-Partners-Solve-Gun-Crimes

recognize that what they are doing matters, to be motivated to continue doing it, and to be recognized and able to participate in the resulting successes.

Exhibit 3. CGIC workflow



An Assessment of the Phoenix CGIC

Process findings

The evaluation team conducted a process assessment to examine whether the CGIC's activities were carried out according to plan during its first two years. We reviewed processes and compared findings from the year prior to the CGIC's implementation (i.e., the pretest period, Oct. 2016-Sep. 2017) with findings from the first and second years of the CGIC's operation (i.e., posttest periods 1, Oct. 2017-Sep. 2018, and 2, Oct. 2018-Sep. 2019). We selected processes from two broad-based activities: (a) gathering and processing physical criminal evidence from gun crimes (e.g., fired cartridge casings collected at shooting scenes and guns recovered from prohibited possessors) and (b) carrying out basic investigatory tasks (e.g., tracing firearms through the ATF's eTrace network and identifying NIBIN leads). Overall, our findings indicate that the processes planned had been carried out as intended.

Collecting ballistic evidence

Comparing the number of incidents police responded to that produced ballistic evidence in the pretest year to the number of such incidents in the CGIC's first and second (posttest) years, we found that the number yielding ballistic evidence had increased 9% in posttest period one and 7% in posttest period two. Again in comparison with the pretest period, the number of guns collected increased 18% in posttest period one and 13% in posttest period two. (See exhibit 4).

Exhibit 4. Incidents responded to by police and producing ballistic evidence and guns (pretest/posttest)

	Pretest	Posttest 1	Posttest 2	Change - pretest to posttest 1	Change - pretest to posttest 2	Change - posttest 1 to posttest 2
	#	#	#	# (%)	# (%)	# (%)
PPD incidents responded to w/ evidence	3,965	4,329	4,238	+364 (+9)	+273 (+7)	-91 (-2)
Incidents w/ casings collected [a]	1,359	1,446	1,400	+87 (+6)	+41 (+3)	-46 (-3)
Incidents w/ guns collected	3,037	3,421	3,329	+384 (+13)	+292 (+10)	-92 (-3)
Guns collected	4,296	5,049	4,862	+753 (+18)	+566 (+13)	-187 (-4)

[a] Typically, all casings from a single crime scene are impounded as one item; PPD was unable to determine the count of individually impounded casings.

Processing ballistic evidence – NIBIN entries

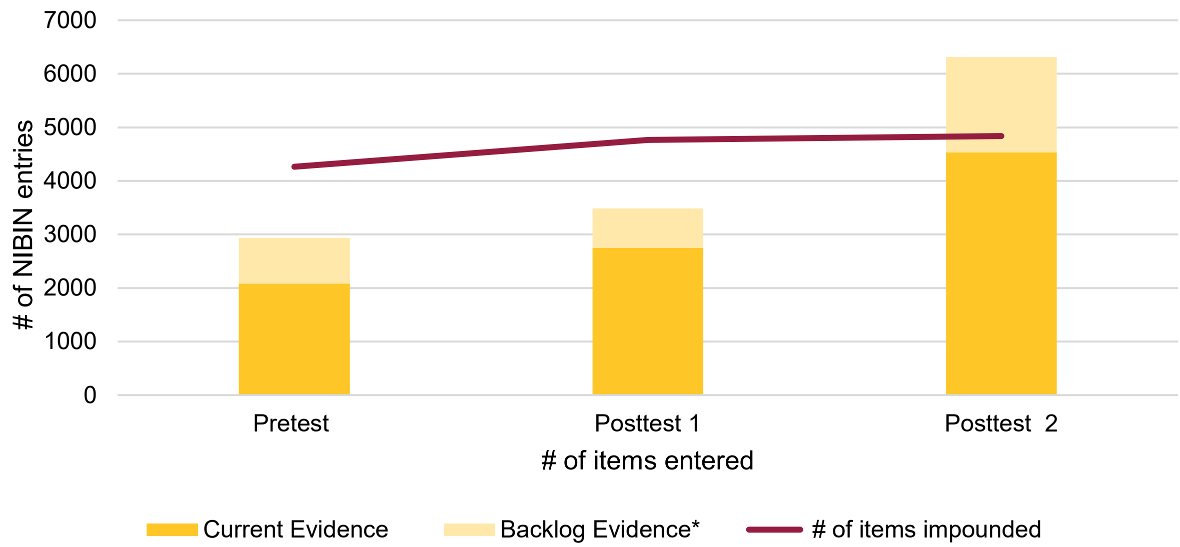
Comparing the number of evidence items eligible for NIBIN entry in the pretest period to the number eligible in the first and second posttest periods, we found that items eligible for NIBIN entry increased 12% in the first posttest period and then stabilized. The number of items entered in NIBIN, compared with the pretest year, increased 32% in posttest period one and 118% in posttest period two. Only 58% of the evidence impounded in the first posttest period was entered during the same year it was collected. In the second posttest period, however, this improved: 94% of the evidence impounded was entered within the same year. (See exhibits 5 & 6.)

Exhibit 5: NIBIN-eligible items impounded (field activities) and NIBIN entries (pretest/posttest)

	Pretest	Posttest 1	Posttest 2	Change - pretest to posttest 1	Change - pretest to posttest 2	Change - posttest 1 to posttest 2
	#	#	#	# (%)	# (%)	# (%)
NIBIN-eligible items impounded	4,265	4,766	4,838	+501 (+12)	+573 (+13)	+72 (+2)
Items entered in NIBIN	2,082	2,749	4,535	+667 (+32)	+2,453 (+118)	+1,786 (+65)
NIBIN-eligible items impounded & entered - same year	49	58	94	+9	+45	+36
Total items entered in NIBIN [a]	2,936	3,484	6,313	+548 (+19)	+3,377 (+115)	+2,829 (+81)

[a] Includes items collected in a previous period but processed and entered during the current period (backlog).
Note: Due to rounding, percentages may not add up to 100.

Exhibit 6. Visualization of NIBIN entries (pretest/posttest)



Processing ballistic evidence – timeliness

PPD official data showed that NIBIN evidence processing times steadily decreased during each of the posttest periods, compared with the pretest period. Comparing the average number of days between a firearm-related incident and NIBIN entry of evidence collected onsite, this interval averaged 127 days in the pretest period, compared to an average of 40 days in posttest period one and an average of 27 days in posttest period two. We also found improvements in the percentage of NIBIN evidence processed within two days of collection; only 3% of the entries reached this timeliness goal in the pretest period, while 25% and 32%, respectively, met the goal in posttest periods one and two; similar improvements were seen for entering evidence within 7 days, 14 days and 30 days. For example, the percentage of evidence collected and processed within 7 days of collection increased more than fivefold between the pretest period and posttest period two, from 12% to 67%. (See exhibit 7.)[11]

Exhibit 7. Average days between evidence collection and NIBIN entry (pretest/posttest)

	Pretest year	Posttest year 1	Posttest year 2	Change - pretest year to posttest year 1 # (%)	Change - pretest year to posttest year 2 # (%)	Change - posttest year 1 to posttest year 2 # (%)
Ave. # days between crime & NIBIN entry	127	40	27	-87 (-69)	-100 (-79)	-13 (-33)
Proportion (%) of processed items entered within:						
24-48 hrs.	3	25	32	+22 (+733)	+29 (+967)	+7 (+28)
7 days	12	46	67	+34 (+283)	+55 (+458)	+21 (+46)
14 days	24	55	77	+31 (+129)	+53 (+221)	+22 (+40)
Within a month of impounding	31	59	80	+28 (+90)	+49 (+158)	+21 (+36)

Note: These data represent the number of days between collection of crime scene evidence and its NIBIN entry, excluding weekends. To avoid skewing the data, we did not include backlogged ballistic evidence.

To better understand how investigators of NIBIN-related incidents were using the CGIC, the PPD, assisted by its research partners, invited those who had served as point-of-contact case coordinators to participate in a survey; the investigators' participation was voluntary. Each survey form was distributed with a particular NIBIN-

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[11] PPD policy, prior to the CGIC, required that any evidence needed for fingerprinting or DNA be processed in the Crime Lab. Effective May 2019, the CGIC modified this policy. Evidence impounded prior to that change was subject to the earlier policy, and CGIU could not process it until after the Lab completed any pending fingerprint and DNA analyses, often months or even years later. Such backlogged items were excluded from our timeliness data.

related case for its lead investigator to think about when answering questions regarding case status at various milestones, its lead notification(s), support received from the CGIU, and case outcomes; we also asked respondents to rate the overall usefulness of lead notifications for advancing their cases.[12]

For the most part, respondents indicated that CGIU support had reduced the length of time between an incident and receipt of a lead notification, an unquestionable prerequisite to the lead notification's investigative usefulness. We conducted bivariate analyses to examine their responses, and found that in the pretest period, the interval between incidents and receipt of their lead notifications had averaged nearly 500 days (median 107); in posttest period one, this average was 213 days (median 156), and in posttest period two, the average was about 132 days (median 16). (See exhibit 8.)

Exhibit 8. Bivariate analyses of average number of days between incidents and lead notifications (pretest/posttest)

	Pretest (n=24)	Posttest 1 (n=68)	Posttest 2 (n=55)	Total (n=147)
Mean (SD)	496.47 (997.69)	212.52 (230.50)	132.11 (229.57)	216.60 (473.37)
Median	107.00	155.50	16.00	53.00
Range	4 - 4189	1 - 892	0 - 1126	0 - 4189
t			1.79	2.98**
ES			0.50	0.79

**$p < 0.01$; *$p < 0.05$ based on *t*-test using pretest period as the reference category; ES= Hedge's *g* effect size

Related, and unsurprising, the investigators' survey responses indicated that lead timeliness was associated with lead helpfulness in an investigation. Examining official data, we found that NIBIN leads described as helpful had been received an average of 117 days following the incident (median 22 days) compared to leads described as unhelpful, which had been received in an average of 418 days (median 345 days). (See exhibit 9.)

[12] For the complete set of survey statistics from the compiled survey responses, see appendix B, exhibit B.1.

Exhibit 9. Comparison of lead helpfulness and lead timeliness

	Days between incident and lead receipt			
	Mean (SD)	Median	*t*	ES
Leads reported helpful	117.10 (184.57)	22	4.75**	0.74
Leads reported not helpful	417.93 (554.25)	344.5		

**$p < 0.01$; * $p < 0.05$ based on *t*-test; ES= Hedge's *g* effect size

Notably, as the length of time taken to process NIBIN evidence decreased (ex. 7), the number of NIBIN entries increased substantially, from 2,936 NIBIN entries in the pretest period to 3,484 entries in posttest period one, and to 6,313 entries in posttest period two (ex. 5). As shown in exhibit 10, as would be expected, the increase in numbers of NIBIN entries produced an increase in number of leads. The number of leads with a PPD nexus (i.e., a link/connection to a PPD case) increased from 175 in the pretest period to 244 in posttest period one, and to 461 in posttest period two. Specifically, the number of leads linking two incidents increased from 124 in the pretest period to 168 in posttest period one and 311 in posttest period two. Leads linking three, four, and five or more incidents similarly increased from the pretest period to both posttest periods.

Exhibit 10. NIBIN leads with two, three, four and five or more linked incidents (pretest/posttest)

	Pretest	Posttest 1	Posttest 2	Change - pretest to posttest 1	Change - pretest to posttest 2	Change - posttest 1 to posttest 2
	# (%)	# (%)	# (%)	# (%)	# (%)	# (%)
NIBIN leads with PPD nexus (#)	175	244	461	+69 (+39%)	+286 (+163)	+217 (+89)
Instances in which NIBIN leads linked…						
2 incidents with PPD nexus	124 (71)	168 (69)	311 (67)	+44 (+35)	+187 (+151)	+143 (+85)
3 incidents with PPD nexus	18 (10)	47 (19)	87 (19)	+29 (+161)	+69 (+383)	+40 (+85)
4 incidents with PPD nexus	10 (6)	12 (5)	36 (8)	+2 (+20)	+26 (+260)	+24 (+200)
5+ incidents with PPD nexus	5 (3)	16 (7)	23 (5)	+11 (+220)	+18 (+360)	+7 (+44)
NIBIN leads that led to cooperation among multiple agencies and PPD	67 (38)	116 (48)	175 (38)	+49 (+73)	+108 (+161)	+59 (+51)

Processing eTrace evidence

CGIC's policies on processing firearms, intended to increase timeliness while preserving evidence integrity, went into effect in May 2018, well into posttest period one. For this reason, performance measures addressed by that policy did not show improvement until partway through the study's posttest periods. More than a year after the CGIC was implemented, but not long after the CGIC firearms policy was implemented, recovered firearms were more likely than before to be traced through the ATF; they also were being traced more quickly, and they were more likely to be traced back to a purchaser.

Before the new policy went into effect, only ATF contractors would request traces, and then only for weapons appearing in a NIBIN lead. Compared with the pretest period, the number of recovered firearms traced actually decreased in posttest period one, from 1,958 traces (46%) pretest to 818 traces (17%) posttest. The number of traces then increased in posttest period two to 3,609 (75%), largely due, we believe, to the new CGIC policy. This was an 84% percent overall increase in the percentage of recovered crime guns that were traced from the pretest period to posttest period two.

Compared to the percentage of the PPD's recovered crime guns traced by the ATF within 24-48 hours in the pretest year (7%), the percentage traced in posttest period one doubled to 14%; however, it decreased again in posttest period two to 6%. Of those traced, the percentage traced to a purchaser increased from the pretest period (78%), stabilizing at 84% in posttest periods one and two. (See exhibit 11.)[13]

Exhibit 11. Recovered guns traced by ATF within 24-48 hours and to purchasers (pretest/posttest)

	Pretest	Posttest1	Posttest 2	Change - pretest to posttest 1	Change - pretest to posttest 2	Change - posttest 1 to posttest 2
				# (%)	# (%)	# (%)
# of recovered crime guns traced	1,958	818	3,609	-1,140 (-58%)	+1,651 (+84%)	+2,791 (+341%)
% of recovered crime guns traced	46	17	75	-29% (-63)	+29% (+63)	+58% (+341%)
# of recovered crime guns traced w/i 24-48 hrs.	130	116	228	-14 (-11)	+98 (+75)	+112 (+97%)
% of recovered crime guns traced w/i 24-48 hrs.	7	14	6	+7% (+100)	-1% (-14)	-8% (-57%)
# of firearms traced to purchaser	1,532	690	3,019	-842 (-55)	+1,487 (+97)	+2,329 (+338%)
% of firearms traced to purchaser	78	84	84	+6% (+8)	+6% (+8)	-

Receiving NIBIN lead notifications

As mentioned above, PPD investigators assigned to coordinate incidents with NIBIN leads that were identified during the study period (October 2017-September 2019) were invited to participate in a survey. The analysis of their responses helped us to understand the CGIC's impact on their investigations. The incidents most often having leads were aggravated assaults, followed by drive-by shootings, robberies and homicides, and prohibited possessors.

[13] PPD is authorized to run firearms considered "crime guns" through NIBIN or eTrace. The ATF defines a crime gun as any firearm that is illegally possessed, used in a crime, or suspected of having been used in a crime. An abandoned firearm may be categorized as a crime gun when it is suspected of being illegally possessed or having been used in a crime. This authority does not extend to firearms impounded for safekeeping or turned over under an order of protection.

For survey purposes, NIBIN leads assigned to the pretest period had been identified during October 2016-September 2017 and for the most part were related to incidents that had occurred within the same timeframe, although some were linked to cases dating as far back as 2003. NIBIN leads assigned to posttest period one had been identified during October 2017-September 2018, and were sometimes linked to incidents dating as far back as 2004. NIBIN leads assigned to posttest period two were identified during October 2018-September 2019, with some being linked to incidents dating as far back as 2007.

The survey responses indicated that investigators were more likely to receive lead notifications after the CGIC had been established (posttest periods 1 & 2) than during the year before (pretest). During the pretest period, they responded, NIBIN lead notifications were received for only about 23% of their cases, while in posttest periods one and two, lead notifications were received for about 45% and 50% of their cases, respectively.

Asked *who* provided their lead notifications, and then allowed to write in an answer, survey respondents said that they had received significantly more notifications directly "from NIBIN" or "the CGIC."[14] or "NIBIN" (i.e., the CGIU); they indicated having received lead notifications from the CGIU for about 29% of cases during the pretest year and for about 58% of cases in the second posttest period.[15] After the CGIC was in place, lead information was received from a co-worker for about 10% of cases, and the remainder was received from supervisors, the RMS ("case management"), or an “other” agency.

Asked *how* that information had been received, respondents indicated that in the pretest period, lead notifications were received by email more than 50% of the time; otherwise, they were received through case management (RMS) (8.3%), in person (8.3%), by mail (8.3%), by phone (4.2%), or from a CGIU detective (4.2%). In the second posttest period, notifications were received less often than before by email (33.5%), mail (1.5%), or a CGIU detective (1%), and more often from case management (RMS) (28%), in person (15.3%), or by phone (9.4%).[16] (See appendix B, exhibit B.1, descriptive statistics.)

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[14] Before the CGIC came into being, the PPD unit managing NIBIN leads was commonly referred to as "NIBIN." That habit persisted afterward, although some began referring to it as "the CGIC." Survey responses varied accordingly across the pre- and posttest periods of the study. Here, for consistency, we use CGIU to represent all answers that referred to the unit responsible for NIBIN leads, regardless of study period. (For the record, the CGIC is the collaborative of law enforcement agencies, and the CGIU is the PPD's gun crime investigative unit.)

[15] The survey asked both "from whom" (e.g., lab, supervisor…) respondents received lead notifications and "how" (e.g., email, phone, in person…) they received them. Write-in answers were allowed, and respondents did not consistently distinguish the difference between these two questions. There was some crossover in their answers.

These changes could be explained in part by the shift to the CGIC's new process for notifying investigators of their NIBIN leads. During the pretest period, leads were not being tracked in the RMS. Later, CGIU personnel worked with the PPD's Information Technology Bureau to create new fields in the RMS to increase the trackability and accuracy of NIBIN leads, thus transitioning away from email-based notifications from case management personnel.

Incident status at time of lead notification

Analysis of investigators' survey responses suggested that they were significantly more likely during the posttest period than during the pretest period to have identified a suspect by the time they received a lead notification. They indicated that, pretest, no suspect had yet been identified at the time they received 75% of their notifications compared to about 48% of their notifications in posttest period one, and 41% in posttest period two. This was largely true for cases that were considered active as the investigator waited for additional investigative leads. During the pretest period, this was the status of about 33% of NIBIN-related incidents, compared to about 12% of such incidents in posttest period one and about 14% in posttest period two. Investigators were significantly more likely to report receiving lead notifications during posttest period two after they had identified at least one suspect by his or her real name (54.0%), compared to the pretest period (25%), and after at least one suspect had been arrested (41.4% posttest period 2 vs. 16.7% pretest period). (See exhibit 12.)

Interviews with PPD personnel suggested a possible explanation for the above findings. Internal evidence processing speeds and preliminary lead identifications by CGIU personnel were providing investigators with potentially actionable information before the ATF and NNCTC could process, review and send the officially confirmed notifications. In some cases, the CGIU was processing evidence in real time and giving oral lead notifications to investigators before they left crime scenes. Due to the CGIU’s active involvement in investigations, suspects had been often been identified based on the real-time (preliminary) NIBIN leads, while official lead documentation and RMS entries were occurring much longer after the fact. (The CGIC data systems did not support an examination of this possible explanation for the current evaluation.)

Exhibit 12. Incident status at time lead notification received (pretest/posttest)

	Pretest (n=24)		Posttest 1 (n=68)				Posttest 2 (n=111)				Total (n=203)	
	#	%	#	%	χ2	ES	#	%	χ2	ES	#	%
No suspects identified	18	75.00	32	47.76	5.30*	0.55	45	40.54	9.41**	0.71	95	47.03
Case still active & being worked regularly	4	16.67	8	11.94	0.34	0.14	17	15.45	0.02	0.03	29	14.43
Case listed as active but awaiting additional leads	8	33.33	8	11.94	5.58*	0.57	16	14.41	4.83*	0.50	32	15.84
Case inactive	6	25.00	17	25.37	0.00	-0.01	9	16.36	0.81	0.22	32	21.92
No suspects identified, but a group (e.g., gang, crew, etc.) id'd as likely suspects	3	12.50	2	2.99	3.08	0.42	6	5.41	2.21	0.28	11	5.45
At least one suspect identified by street name or alias, but true identity still unknown	2	8.33	1	1.49	2.59	0.38	3	2.70	1.75	0.30	6	2.97
At least one suspect identified by real name	6	25.00	27	40.30	1.79	-0.32	61	54.95	7.08**	-0.61	94	46.53
At least one suspect arrested	4	16.67	18	26.87	1.00	-0.23	46	41.44	5.19*	-0.52	68	33.66
At least one suspect charged by the county attorney	1	4.17	8	11.94	1.20	-0.26	17	15.32	2.12	-0.33	26	12.87
At least one suspect awaiting trial	0	0.00	3	4.48	1.11	-0.25	2	1.80	0.44	-0.15	5	2.48
At least one suspect gone to trial	0	0.00	3	4.48	1.11	-0.25	3	2.70	0.66	-0.18	6	2.97
Trial pending or ongoing	0	0.00	1	1.49	0.36	-0.14	2	1.80	0.44	-0.15	3	1.49
Guilty (plead, convicted, sentenced)	0	0.00	5	7.46	1.90	-0.32	3	5.45	1.36	-0.28	8	5.48
Found not guilty	0	0.00	0	0.00	-	-	0	0.00	-	-	0	0.00

**$p < 0.01$; *$p < 0.05$ based on χ^2 test using pretest as the reference category; ES= Hedge's *g* effect size; negative ES means outcome was more likely posttest than pretest.

Impact Findings

An impact evaluation examines whether and how a program or other intervention has been effective. Here, we examine the impact of the CGIC on gun crime investigative processes and outcomes. We begin with survey respondents' perceptions of the efficacy of NIBIN leads, and then show the impact of the CGIC on case clearance rates and prosecutorial outcomes. We have also examined the impact of the PPD's deployment of FireFly, a mobile shots fired-detection technology that was introduced after the CGIC had been implemented, but that we still were able to incorporate into this study.

Impact of lead notifications

Investigators' survey responses indicated that after the CGIC was implemented, in addition to receiving more timely lead notifications, investigators were more than five times as likely to receive assistance with a lead from a CGIU investigator. In both posttest periods, CGIU assistance was received with more 40% of NIBIN-related incidents being investigated; this was true for only about 8% of such incidents in the pretest period.

Investigators assigned to NIBIN-related incidents during the first posttest period (the first year of the CGIC) were significantly more likely than those assigned during the pretest period to indicate that the lead had helped to identify a group (11.8% vs. 8.3%), to identify at least one suspect by street name or alias (7.5% vs. 8.3%), to identify a suspect by their real name (32.4% vs. 8.3%), to aid during an interrogation (19.1% vs. 4.2%), to aid in the arrest of a suspect (23.5% vs. 8.3%), to charge a suspect (25.0% vs. 8.3%), and to aid in the sentencing of a suspect (5.9% vs. 4.2%). We observed similar trends when comparing responses about posttest period two to those about the pretest period, although these differences were not statistically significant.

Finally, the survey data showed that respondents were more likely to report that their lead notifications were helpful for incidents they were investigating after, compared to before, the implementation of the CGIC. Specifically, during the pretest period, lead notifications were helpful in about 36% of their investigations, compared to about 63% of their investigations in posttest period one and 55% of their investigations in posttest period two. (See exhibit 13.)

Exhibit 13. Survey responses - impact of CGIU and lead notifications (pretest/posttest)

	Pretest (n=24)		Posttest 1 (n=68)				Posttest 2 (n=111)				Total (n=203)	
	#	%	#	%	χ2	ES	#	%	χ2	ES	#	%
Offered assistance w/lead by a CGIU detective?					12.88**	0.17			26.09**	-0.45		
No	12	50.00	14	20.59			14	12.61			40	19.70
Yes	2	8.33	31	45.59			46	41.44			79	38.92
Not sure	7	29.17	18	26.47			15	13.51			40	19.70
Missing	3	12.50	5	7.35			36	32.43			44	21.67
Did lead notification help												
ID group as likely suspects	2	8.33	8	11.76	11.99**	0.85	15	13.51	2.76	0.37	25	12.32
ID suspect by a street name/alias, true identity unknown	2	8.33	5	7.46	12.31**	0.84	9	8.11	3.15	0.37	16	7.92
ID suspect by their real name	2	8.33	22	32.35	12.16**	0.85	35	31.53	5.35	0.37	59	29.06
Aid during suspect interrogation	1	4.17	13	19.12	12.01**	0.85	20	18.02	3.81	0.37	34	16.75
Aid in arrest of suspect	2	8.33	16	23.53	11.73**	0.85	16	14.41	2.76	0.37	34	16.75
Charge suspect (by county atty)	2	8.33	17	25.00	11.77**	0.85	19	17.12	0.39	0.37	38	18.72
Secure plea bargain	3	12.50	8	11.76	13.15**	0.85	5	4.50	6.97*	0.38	16	7.88
Advance the case to trial	1	4.17	2	2.94	12.36**	0.85	4	3.60	3.02	0.37	7	3.45
In sentencing suspect	1	4.17	4	5.88	11.82**	0.85	6	5.41	3.08	0.37	11	5.42
Overall, how helpful was lead notification (or information notification helped reveal)?					5.27	0.46			2.83	0.33		
Helpful	8	36.36	40	63.49			61	55.45			109	55.90
Neutral	13	59.09	20	31.75			44	40.00			77	39.49
Unhelpful	1	4.55	3	4.76			5	4.55			9	4.62

**$p < 0.01$; *$p < 0.05$ based on χ^2 test using pretest as the reference category; ES= Hedge's *g* effect size; missing data not included; valid percentages reported

Impact of the CGIC on clearance rates

We first examined the impact of the CGIC on clearance rates across several offense types, for incidents where a gun was present and later identified through impounded gun or casing evidence qualifying for NIBIN entry. Specifically, we examined the impact of the CGIC on NIBIN-related case clearance rates for aggravated assault, armed robbery, murder/attempted homicide, carrying a weapon/deadly weapon, discharging a firearm/weapon, drive-by shootings, and “other” crimes (see exhibit 14). We compared clearance rates one year prior to the implementation of the CGIC (pretest period) to the clearance rates one and two years following its implementation (posttest periods 1 & 2). We contextualized these changes by comparing NIBIN-related cases to non-NIBIN cases.

A limitation to this methodology is that NIBIN- and non-NIBIN-related cases are not necessarily equivalent. Ideally, for evaluation purposes, we would have randomly assigned gun crimes involving a NIBIN lead to the CGIU for investigation; however, this obviously was not possible, as all cases involving a NIBIN lead are managed by CGIU investigators. Therefore, we compared NIBIN-related cases with non-NIBIN cases by type of offense. This was unavoidably problematic in that offenses involving a gun with a NIBIN lead are unique when compared to offenses not known to involve a gun that has been used in a crime more than once. Nevertheless, non-NIBIN case data do provide context for any observed changes in CGIU case outcomes.

Following the implementation of the CGIC, clearance rates increased for almost all crime types examined. For example, between the pretest period and the second posttest period, clearance rates for NIBIN-related cases increased by 36% for murder, 15% for aggravated assault, 14% for carrying a weapon, and 8% for discharging a firearm; at the same time, clearance rates held relatively stable for non-NIBIN cases across these offense types. Likewise, while clearance rates for all crime types examined increased by 14% for NIBIN-related cases, they increased by only 2% for non-NIBIN cases. While other crimes clearance rates remained stable for non-NIBIN cases, NIBIN-related case clearances increased by 27% from the pretest period to the second posttest year.

Clearance rates for NIBIN-related cases investigated by the CGIU, however, did not improve for armed robbery or drive-by shootings, and in fact declined, but these types of incidents were relatively rare events (i.e., $n \leq 35$ a year).

Exhibit 14. Clearance rates of gun crime types, NIBIN-related and non-NIBIN-related cases (pretest/posttest)

	Pretest		Posttest 1		Posttest 2	
	NIBIN cases	Non-NIBIN cases	NIBIN Cases	Non-NIBIN cases	NIBIN cases	Non-NIBIN cases
Aggravated Assault						
#Incidents	65	384	92	376	86	420
#Arrests	15	198	28	220	33	234
Clearance rate (%)	23	52	30	59	38	56
Armed Robbery						
#Incidents	14	123	35	114	27	97
#Arrests	12	74	24	81	14	66
Clearance rate (%)	86	60	69	71	52	68
Murder/Attempted Homicide						
#Incidents	11	87	16	65	32	58
#Arrests	4	53	10	46	23	39
Clearance rate (%)	36	61	63	71	72	67
Carry Weapon/Deadly Weapon [a]						
#Incidents	23	471	45	586	56	529
#Arrests	14	366	39	481	42	437
Clearance rate (%)	61	78	87	82	75	83
Discharging Firearm/Weapon						
#Incidents	115	351	163	355	173	363
#Arrests	2	49	16	81	18	92
Clearance rate (%)	2	14	10	23	10	25
Drive by Shooting						
#Incidents	18	20	15	15	23	15
#Arrests	3	1	3	0	1	1
Clearance rate (%)	17	5	20	0	4	7
Other Crimes						
#Incidents	56	979	85	1,037	82	1,206
#Arrests	12	434	28	439	39	514
Clearance rate (%)	21	44	33	42	48	43
Total						
#Incidents	302	2,415	451	2,548	479	2,688
#Arrests	62	1,175	148	1,348	170	1,383
Clearance rate (%)	21	49	33	53	35	51

[a] These data reflect clearance rates for firearm-related possession and carrying offenses, including AVN/carrying a gun, carry deadly weapon, concealed weapon on person/in control, disorderly conduct–weapon/instrument, firearm possession–adj. delinquent, minor carry/possession, misconduct involving weapons, possession/use of weapons, prohibited weapon–manufacture/possess/sell, sell/give/provide weapon, and trafficking in weapons or explosives. These firearms-related offenses are collapsed here for ease of presentation.

Impact of CGIC on prosecutorial outcomes

Among the key purposes of the CGIC overall, and the CGIU in particular, are to assist investigations, increase arrests, and aid in achieving favorable prosecutorial outcomes. To examine the impact of the CGIC and CGIU on these outcomes, we compared data collected from one year prior to their implementation (pretest) to data for one and two years after they were implemented (posttest years 1 & 2). We contextualized prosecutorial outcomes by describing case flow from the point of a NIBIN lead, to arrest, to prosecutorial charging, to conviction. (Cases that remained open and with the prosecutor's office were eliminated from the analysis (pretest period, n= 558; posttest period 1, n= 1229; posttest period 2, n= 2744.)

The percentage of cases in which an arrest was aided by a NIBIN lead increased from 21% in the pretest period to 33% and 35% in posttest periods one and two, respectively; this compared to little change in clearance rates for those without a NIBIN lead. The proportion of NIBIN-related cases charged by the prosecutor's office declined substantially from 61% in the pretest period to 55% in posttest period one and 41% in posttest period two; the charging of non-NIBIN cases declined as well, from about 64% of cases charged in the pretest period to 63% and 50% of cases charged in posttest periods one and two, respectively. The percentage of NIBIN-related cases resulting in a conviction declined from about 95% in the pretest period, to 90% in posttest period one, and 87% in posttest period two; conviction rates for non-NIBIN cases held fairly stable over the study period. (See exhibit 15.)

Exhibit 15. Arrest and prosecutorial outcomes, NIBIN-related and non-NIBIN gun crime cases (pretest/posttest)

	Pretest n=2725		Posttest 1 n=3010		Posttest 2 n=3188	
	NIBIN cases	Non-NIBIN cases	NIBIN cases	Non-NIBIN cases	NIBIN cases	Non-NIBIN cases
	# (%)	# (%)	# (%)	# (%)	# (%)	# (%)
Incidents	302 (100)	2,423 (100)	451 (100)	2,559 (100)	480 (100)	2,708 (100)
Arrests	62 (21)	1,176 (49)	148 (33)	1,348 (53)	170 (35)	1,384 (51)
Charged	38 (61)	754 (64)	81 (55)	854 (63)	70 (41)	687 (50)
Convicted	36 (95)	708 (94)	73 (90)	798 (93)	61 (87)	649 (94)

As seen in exhibit 16, we further examined the effect of the evidentiary value of the CGIC on clearance rates and prosecutorial outcomes for gun crimes by calculating difference in difference (DID) models. DID models are used to determine whether over time a treatment group, here NIBIN-related cases, significantly changed relative to the control group, here non-NIBIN cases, while accounting for potential time period effects that may occur in the control group and that are tangential to the treatment. The results revealed that cases in the posttest period with a NIBIN lead had 75.7% greater odds of an arrest ($p < 0.001$) when compared to those cases in the pretest period without a NIBIN lead. However, cases in the posttest period with a NIBIN lead were not significantly more likely to be charged or to result in a conviction.

Exhibit 16. Difference-in-Difference estimate of clearance rates and prosecutorial outcomes

	OR (95% CI)	*z*-Test
Arrests		
Treatment	0.27 (0.20 – 0.37)	-8.74***
Posttest	1.14 (1.04 – 1.26)	2.72**
Treatment x Posttest (DID estimator)	1.76 (1.27 – 2.43)	3.40***
Charged		
Treatment	0.32 (0.22 – 0.45)	-6.39***
Posttest	0.92 (0.82 – 1.02)	-1.66
Treatment x Posttest (DID estimator)	1.47 (0.99 – 2.18)	1.90
Convicted		
Treatment	1.17 (0.27 – 5.01)	0.21
Posttest	1.00 (0.70 – 1.44)	0.00
Treatment x Posttest (DID estimator)	0.44 (0.09 – 2.07)	-1.04

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Impact of number of days between incident and lead notification on incident outcomes

Exhibits 17 and 18 present our regression analysis examining the perceived relationship between CGIC implementation and several outcomes related to incident progress. The number of days between an incident and its lead notification serves as an independent variable, in part to control for issues related to the temporal ordering of incidents. The results show that one and two years following implementation of the

CGIC, investigators indicated, suspects were no more likely to be identified, suspects were no more likely to be identified by name, groups were no more likely to be identified, and suspects were no more likely to be arrested or charged.

Exhibit 17. Logistic regression predicting incident outcomes (pretest/posttest 1)

	No suspect identified		Inactive		No suspect ID, but group identified		Suspect identified by name		1+ suspect(s) arrested		1+ suspect(s) charged		1+ suspect(s) guilty	
	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR
Post-CGIC (posttest)	-1.11	0.33	0.34	1.40	-1.59	0.20	1.23	3.42	1.32	3.74	0.32	1.38	1.67	5.30
	(0.76)	(0.25)	(0.74)	(1.04)	(1.29)	(0.26)	(0.80)	(2.74)	(0.90)	(3.36)	(0.98)	(1.36)	(1.15)	(6.10)
Days between incident & lead notification	0.00	1.00	0.00	1.00	-0.00	1.00	-0.00	1.00	-0.00	1.00	-0.02	0.98	-0.01	0.99
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
Constant	0.14	1.16	-1.10	0.33	-1.67*	0.19*	-0.56	0.57	-1.05	0.35	-0.54	0.58	-1.81	0.16
	(0.69)	(0.80)	(0.70)	(0.23)	(0.85)	(0.16)	(0.73)	(0.42)	(0.82)	(0.29)	(0.90)	(0.52)	(1.08)	(0.18)
Observations	42	42	42	42	42	42	42	42	42	42	42	42	42	42

Standard errors in parentheses, ** $p < 0.01$, * $p < 0.05$

Note: Guilty includes suspects who pled, were convicted, and were sentenced (too few cases so to present)

Exhibit 18. Logistic regression predicting incident outcomes (pretest/posttest 2)

	No suspect identified		Inactive		No suspect ID, but group identified		Suspect identified by name		1+ suspect(s) arrested		1+ suspect(s) charged		1+ suspect(s) guilty	
	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR	β (SE)	OR
Post-CGIC (posttest)	-0.80	0.45	-0.06	0.94	-1.02	0.36	1.00	2.70	0.26	1.30	0.15	1.16		
	(0.68)	(0.31)	(0.72)	(0.67)	(1.00)	(0.36)	(0.73)	(1.98)	(0.87)	(1.13)	(0.87)	(1.02)		
Days between incident & lead notification	0.00	1.00	0.00	1.00	-0.00	1.00	-0.00	1.00	-0.00	1.00	-0.00	1.00	-0.02	0.98
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.05)
Constant	0.50	1.65	-1.25	0.29	-1.61	0.20	-1.02	0.36	-1.43	0.24	-1.47	0.23	-1.38	0.25
	(0.65)	(1.07)	(0.69)	(0.20)	(0.85)	(0.17)	(0.70)	(0.25)	(0.83)	(0.20)	(0.83)	(0.19)	(1.46)	(0.37)
Observations	61	61	61	61	61	61	61	61	61	61	61	61	14	14

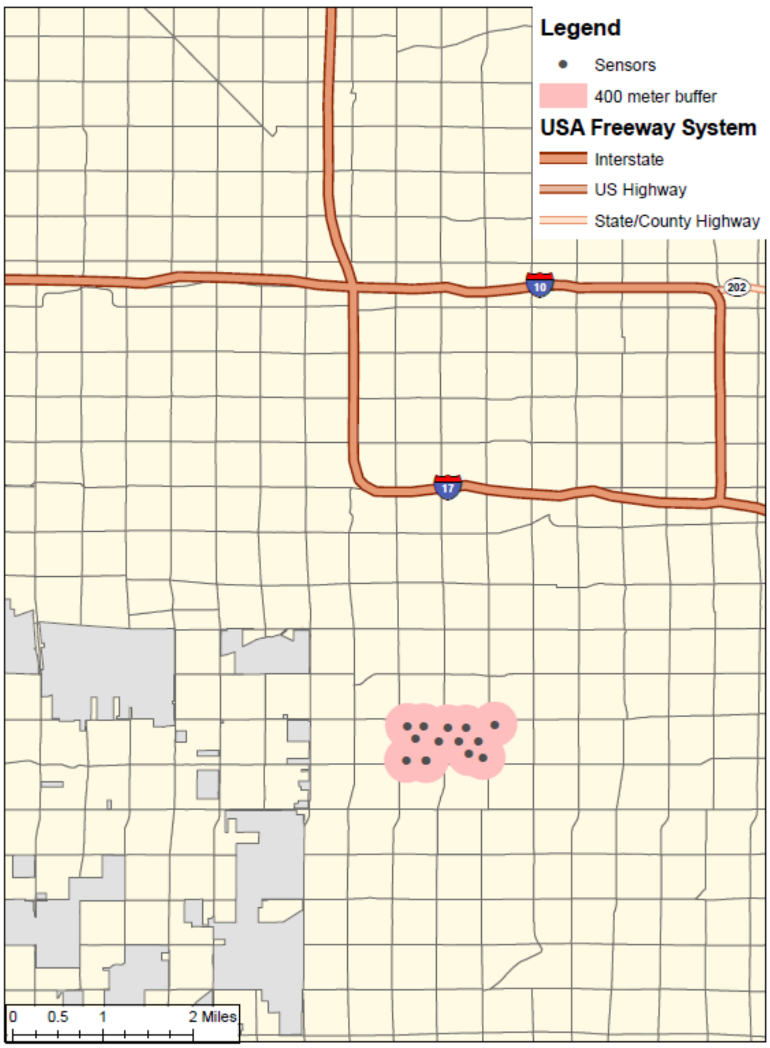
Standard errors in parentheses; ** $p < 0.01$, * $p < 0.05$

Note: Guilty includes suspects who pled, were convicted, and were sentenced.

Impact of FireFly – CGIC's mobile gunshot detection system

As part of the CGIC's response to gun crime incidents, and to examine the potential impact of mobile gunshot detection technology on police responses to shots fired-related calls, a series of FireFly sensors were placed in a high-gun crime area of Phoenix. The PPD mapped shots fired-related gun crimes (i.e., shots fired, shootings, subject with a gun) to help determine where these could be most useful. PPD's jurisdiction is divided geographically into 1,503 map grids, averaging 0.22 square miles each (SD= 0.08 sq mi). (See exhibit 19.)

Exhibit 19. FireFly sensors and buffers (1/2/20 to 5/25/20)

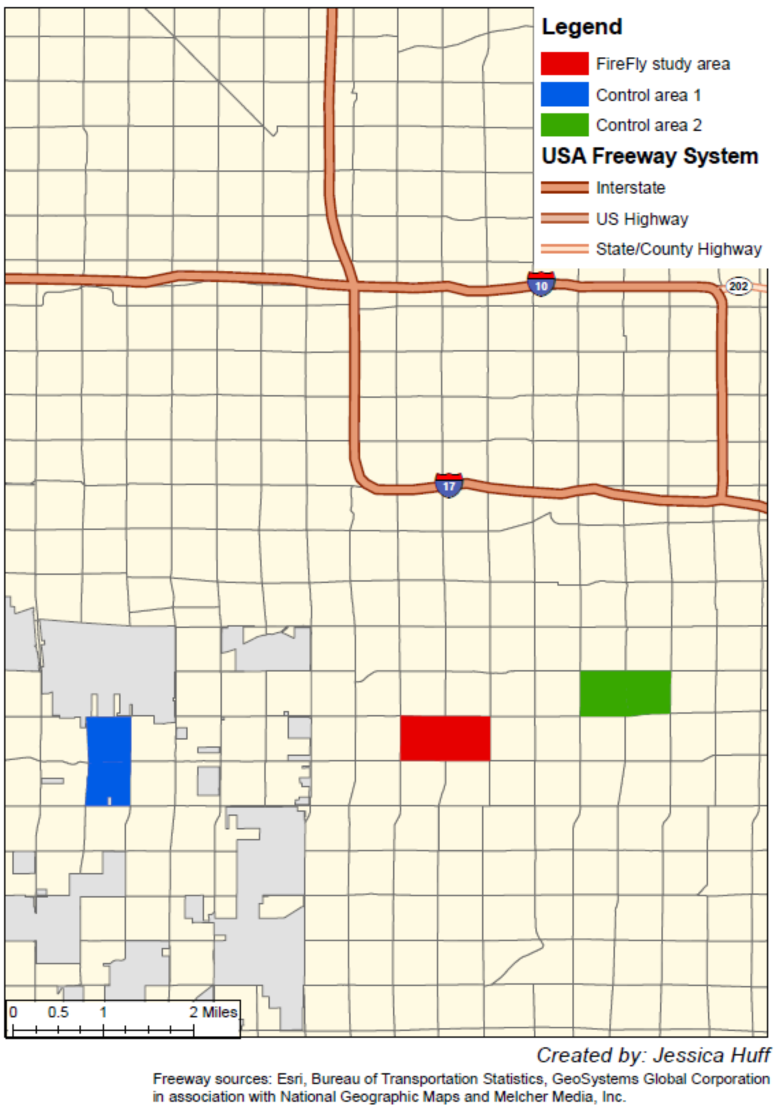


Created by: Jessica Huff

Freeway sources: Esri, Bureau of Transportation Statistics, GeoSystems Global Corporation in association with National Geographic Maps and Melcher Media, Inc.

Two adjacent map grids accounted for the greatest number of shots-fired incidents in the pretest period; these were selected as the study area. FireFly sensors were deployed from January 2 through May 25, 2020, with the expectation that FireFly would capture every gunshot occurring during the study period in the two-grid study area. This area was then compared to two additional pairs of control grids (i.e., control areas 1 & 2) that were known to experience high numbers of shots fired-related calls for service; it would also be compared to all remaining PPD grids not selected for treatment.[17] (See exhibit 20.)

Exhibit 20. FireFly study and control areas (1/2/20 to 5/25/20)



[17] Control grids were selected using k-nearest neighbor matching. Control area 1 is the most similar to the study area, followed by control area 2. See appendix A for additional information about the selection of study and control areas and related descriptive statistics (ex. A.1).

We examined the number of shots fired-related calls for service (CFS) from citizens and the number of FireFly activations in the study area, the two control areas, and the remainder of PPD's jurisdiction. We documented 123 shots fired-related incidents in the study area. Fifteen incidents (12.2%) were reported by citizens but review of the Firefly activations by dispatchers determined the source of the noise was likely not gunfire; 18 incidents (14.6%) were reported by citizens and did activate FireFly; the majority of the incidents (86, 69.9%) activated FireFly but were unreported by citizens. The details of the remaining four incidents (3.3%) were unknown; this suggests that in total 19 shots fired-related incidents (17.9%) in the study area were captured by FireFly but were determined not to be gun shots following an auditory review, and a CFS was not generated as a result.

In control area one, no gunshot incidents activated FireFly, although 23 incidents were reported by citizens. In control area two, FireFly was activated by only two of 19 gunshot incidents reported by citizens. Overall, of 7,087 shots fired-related incidents documented during the FireFly study period, its sensors captured 60 (0.85%) incidents that were reported by citizens and 368 (5.2%) incidents not reported by citizens. (See exhibits 21 & 22.) Although not studied, it would be reasonable to think that the FireFly alerts would enhance rather than simply duplicate citizen reports of gunfire, pinpointing the location of the incident and potential evidence, and lowering response times.

Exhibit 21. FireFly activations (1/2/20 to 5/25/20)

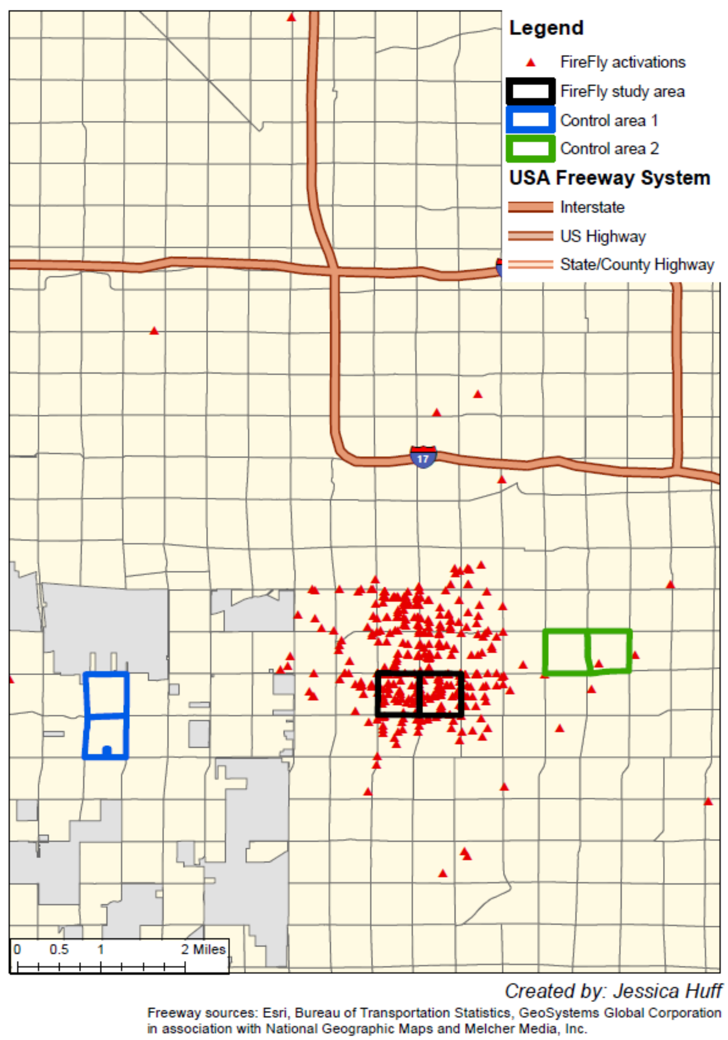


Exhibit 22. FireFly study - gunshot call source by area (1/2/20 to 5/25/20)

	Study area	Control area 1		Control area 2		Non-study area		Total
	#	# (%)	Hedge's *g*	# (%)	Hedge's *g*	# (%)	Hedge's *g*	# (%)
CFS without FF	15 (12.2)	23 (100)	2.89	15 (78.95)	1.94	5,982 (90.79)	2.71	6,333 (89.36)
CFS & FF	18 (14.63)	0 (0)	-0.45	2 (10.53)	-0.12	41 (0.62)	-1.53	60 (0.85)
FF without CFS	86 (69.92)	0 (0)	-1.64	0 (0)	-1.62	276 (4.19)	-3.16	368 (5.19)
Unknown	4 (3.25)	0 (0)		2 (10.53)		290 (4.4)		326 (4.6)
Total	123 (100)	23 (100)		19 (100)		6,589 (100)		7,087 (100)

Note. Hedge's *g* used for effect size; study area used as reference category.

To determine whether FireFly had resulted in false positives (activation without a gunshot) or false negatives (gunshot without activation), we assessed the relationship between citizen calls, FireFly activations, and PPD incident reports. A citizen call with an incident report was counted as a probable gunshot incident; a citizen call without an incident report was counted as a probable false report or an unlocated shot; an incident report without a citizen call was counted as an unreported incident. Sometimes we found indications of an incident without a citizen call or incident report; these we considered as "unlikely a gunshot" or, alternatively, an "unlocated gunshot."

Of a total of 123 documented gunshot-related incidents in the study area, 104 (84.6%, not shown) had activated FireFly. Twelve (11.5%) of the activations were associated with a citizen call and an incident report; six (5.8%) were associated with a citizen call but no incident report (suggesting that the officer responding could not locate the gunshot site and/or that no evidence was found); 23 (22.1%) were associated with an incident report without a citizen call, suggesting that FireFly had detected actual gunshots that were otherwise unreported; 63 (60.6%) activations were associated with neither a citizen call nor an incident report, suggesting either a false positive or that the site could not be located.

Nineteen (15.4%, not shown) of the gunshot-related incidents in the study area examined had not activated FireFly. Of these, 13 (68.4%) were reported by a citizen but did not result in an incident report, suggesting that the citizen may have been mistaken; two (10.5%) were reported by a citizen and an incident report was created, suggesting a false negative (i.e., a shot was fired but not detected by FireFly). Two (10.5%) incident reports were unassociated with either a citizen call or an activation; these may have been officer-initiated responses to shots fired. An additional two were identified by some other means, and were not associated with a FireFly activation, a citizen call, or an incident report. (See exhibit 23.)[18]

Exhibit 23. FireFly study: Activations related to citizen calls-for-service (CFS) and incident reports (IR) of gunshot-related incidents (1/2/20-20-5/25/20)

	Incidents w/ FireFly activation	Incidents w/o FireFly activation	Total incidents
	(n=104)	(n=19)	(n=123)
	# (%)	# (%)	# (%)
CFS w/incident report	12 (11.54)	2 (10.53)	14 (11.38)
CFS, w/o incident report	6 (5.77)	13 (68.42)	19 (15.45)
Incident report w/o CFS	23 (22.12)	2 (10.53)	25 (20.32)
W/O CFS & w/o incident report	63 (60.58)	2 (10.53)	65 (52.85)

Note: Due to rounding, percentages may not add up to 100.

We examined whether FireFly's deployment in the study area had changed officers' responses to shots fired-related calls and their ability to collect evidence. We also examined whether officers' response times had changed in the study area, the two control areas, and the remainder of the city (non-study area). Exhibit 24 shows the within-group change for each area, comparing the 145-day posttest study period for FireFly (1/2/20 to 5/25/20) to the same 145-day pretest period (1/2/19 to 5/25/19).[19] Given the small number of shots fired-related incidents that occurred, and due to the short timeframe and relatively small geographic areas, both statistical significance and effect size changes (i.e., measure of magnitude) are reported.

Thirty-five shots fired-related incidents occurred in the study area during the 2019 pretest period; the number of such incidents increased to 123 during posttest period in 2020, with 104 of these activating FireFly. We found a large effect size difference in the percentage of such incidents to which an officer responded. During the pretest period, officers responded to 34.3% of gunshot incidents in the study area; during the study period, officers responded to 89.4% of such incidents, a statistically significant increase ($p < 0.01$; Hedge's g= -1.55).

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[18] Following this analyses we later learned that both of these incidents were a result of one a detective listening to the Firefly activations and determining that our dispatchers had mis-classified an actual gunshot and had dismissed it as coming from another source, therefore not creating a CFS. As a result, the detective contacted dispatch and asked them to send patrol to the locations of the activations to try and locate casings. In one of the two, casings were recovered.

[19] We also conducted this analysis for the 145-day interval immediately preceding the implementation of FireFly, and the results were largely the same. We report comparisons between the same dates in separate years in order to address potential seasonality. For results using the interval immediately prior to FireFly's deployment, see appendix A.

Small effect size changes were identified between the pretest and study periods in the numbers of incidents with incident reports and with impounded casings. During the pretest period, incident reports were created for only 17.1% of the incidents; posttest, this increased significantly to 31.7% ($p < 0.01$; Hedge's g= -0.32). During the pretest period, casings were impounded for 8.6% of incidents; this increased posttest to 25.2% ($p < 0.05$; Hedge's g= -0.41).

From pretest to posttest, the numbers of firearms impounded and of arrests also increased; these changes, however, were neither statistically significant nor substantively meaningful. Also not statistically significant, small effect size differences occurred in the average time intervals between calls being received and dispatched (g= 0.53) and calls being received and officers arriving at the scene (g= 0.53). Each measure of response time decreased by about four minutes from pretest to posttest.

Control area 1 also experienced change. Small effect size differences indicated that firearms were more likely to be impounded during the posttest period (Hedge's g= -0.37) relative to the pretest period, although not to the level of statistical significance. In control area 1, there were significant changes from pretest to posttest in each measure of officer response time. There was a statistically significant, medium effect size reduction in the time between a call being dispatched and an officer arriving at the scene ($p < 0.05$; g= 0.74), and a significant increase in the time between a call being received and an officer being dispatched ($p < 0.05$), although the difference was not substantively meaningful (g= -0.10). Also not substantively meaningful (g= 0.17), there was a significant decrease in the time from a call being received to an officer arriving on the scene ($p < 0.01$).

Control area 2 experienced 14 shots fired-related incidents during the pretest period and 19 such incidents during the posttest period. There were small, statistically insignificant increases in the number of officer responses (Hedge's g= -0.43) and the number of casings impounded (Hedge's g= -.32) from the pretest to the posttest period. There was also a small effect size increase in the time interval between a call being received and dispatched (Hedge's g= -0.38) and the interval between a call being received and an officer arriving (Hedge's g= -0.33); these were not statistically significant.

Finally, we examined change that occurred across all 1,501 PPD non-study areas without FireFly. Although there were statistically significant increases in the likelihood of an officer responding at an incident ($p < 0.01$), an incident report being created ($p < 0.01$), and casings being impounded ($p < 0.01$), none of these differences were substantively meaningful in terms of effect size. There were significant increases in the time interval between a call being received and dispatched ($p < 0.05$), and the time between a call being received and an officer arriving ($p < 0.05$); these differences also were not substantively meaningful. (See exhibit 24.)

Exhibit 24. Within-group bivariate comparisons of response measures by area

	Study area (n=2 grids)			Control area 1 (n=2 grids)			Control area 2 (n=2 grids)			Non-study area (n=1501 grids)		
	Pretest # (%)	Posttest # (%)	ES	Pretest # (%)	Posttest # (%)	ES	Pretest # (%)	Posttest # (%)	ES	Pretest # (%)	Posttest # (%)	ES
Incidents (#)	35	123		14	23		14	19		4,704	6,589	
FireFly activations	0 (0)	104 (84.55)**	-2.62	0 (0)	0 (0)	-	0 (0)	2 (10.53)	-	0 (0)	317 (4.81)**	-0.3
Officer responses	12 (34.29)	110 (89.43)**	-1.55	5 (35.71)	10 (43.48)	-0.15	7 (50)	10 (52.63)	-0.43	1,639 (34.84)	2,451 (37.20)**	-0.1
Incident reports created	6 (17.14)	39 (31.71)	-0.32	2 (14.29)	5 (21.74)	-0.18	3 (21.43)	7 (36.84)	-0.05	636 (13.52)	1,022 (15.51)**	-0.1
Casings impounded	3 (8.57)	31 (25.2)*	-0.41	2 (14.29)	5 (21.74)	-0.18	3 (21.43)	5 (26.32)	-0.32	376 (7.99)	638 (9.68)**	-0.1
Firearms impounded	1 (2.86)	4 (3.25)	-0.02	0 (0)	2 (8.7)	-0.37	1 (7.14)	2 (10.53)	-0.11	142 (3.02)	202 (3.07)	-0
Arrests	1 (2.86)	4 (3.25)	-0.02	0 (0)	1 (4.35)	-0.26	1 (7.14)	1 (5.26)	-0.11	144 (3.06)	173 (2.63)	0.03
Time in minutes from/to:												
Incoming call/ dispatch	5.34 (13.14)	1.77 (5.67)	0.5 3	5.36 (2.66)	6.28 (10.98)*	-0.10	1.23 (0.50)	4.54 (10.76)	-0.38	6.75 (23.74)	7.49 (28.00)*	-0.03
Dispatch/ officer arriving	3.64 (2.45)	3.16 (2.85)	0.1 7	8.28 (5.89)*	5.09 (2.88)*	0.74	2.58 (0.63)	2.58 (2.25)	-0.00	5.34 (11.18)	4.64 (8.79)	0.07
Incoming call/ officer arriving	8.98 (13.81)	4.93 (6.57)	0.5 3	13.28 (6.26)	11.38 (11.71)**	0.17	3.81 (0.88)	7.12 (12.41)	-0.33	12.00 (28.42)	12.10 (31.57)*	-0.00

**$p < 0.01$; *$p < 0.05$ based on χ^2 and *t*-tests; ES= Hedge's *g* effect size; using pretest as the reference category

Note: FireFly pretest period - 1/2/19 to 5/25/19; posttest period - 1/2/20 to 5/25/20.

We next examined differences between the study and control areas, as shown in exhibits 25 and 26. Exhibit 25 shows the pretest differences between the study and control areas, and Exhibit 26 shows the posttest differences between the study and control areas, after FireFly was deployed.

Pretest. As shown in exhibit 25, some notable differences were found between the study area, control areas, and the remainder of the city (non-study area) prior to FireFly being deployed. Beginning with control area 1, there was a large effect size difference in the time between a call being dispatched and an officer arriving ($p < 0.05$; g= 1.19), suggesting that, pretest, officers responded more quickly to incidents in the study area than in control area 1. Although not statistically significant, a small effect size difference also was found in the time between a call being received and an officer arriving on the scene (g= 0.33).

Between the study area and control area 1, there were also small (nonsignificant) effect size differences in the number of casings impounded (Hedge's g= 0.18) and the number of firearms impounded (Hedge's g= -0.18). Comparing the study area to control area 2 revealed small to medium, although nonsignificant. differences in officers responding to incidents (g= 0.31), impounding casings (g= 0.38), impounding firearms (g= 0.21), and conducting arrests (g= 0.21), with these outcomes being more likely to occur in control area 2 than in the study area.

Small to medium effect size differences were found in every measure of response time examined prior to FireFly being deployed (Hedge's g ranging from -0.37 to -0.50), suggesting that officers responded to incidents more quickly in control area 2. Comparing the study area to the non-study area prior to FireFly deployment did not reveal any statistically significant or substantively meaningful differences. Nevertheless, these minor differences between the study area and the control areas that existed prior to FireFly being deployed should be considered when comparing shots fired-related incidents that occurred in these areas after the implementation of FireFly.

Exhibit 25. Between-group bivariate comparisons, study to control areas

	Study area (n=2 grids)		Control 1 area (n=2 grids)			Control 2 area (n=2 grids)			Non-study area (n=1501 grids)		
	Pretest (#/%)	Posttest (#/%)	Pretest (#/%)	Hedge's *g*	Posttest (#/%)	Pretest (#/%)	Hedge's *g*	Posttest (#/%)	Pretest (#/%)	Hedge's *g*	Posttest (#/%)
Incidents (#)	35	123	14		23	14		19	4,704		6,589
FireFly activations	0 (0)	104 (84.55)	0 (0)	-	0 (0)**	0 (0)	-	2 (10.53)**	0 (0)	-	317 (4.81)**
Officer responses	12 (34.29)	110 (89.43)	5 (35.71)	0.03	10 (43.48)**	7 (50)	0.31	10 (52.63)**	1,639 (34.84)	0.01	2,451 (37.20)**
Incident reports created	6 (17.14)	39 (31.71)	2 (14.29)	-0.07	5 (21.74)	3 (21.43)	0.11	7 (36.84)	636 (13.52)	-0.11	1,022 (15.51)**
Casings impounded	3 (8.57)	31 (25.2)	2 (14.29)	0.18	5 (21.74)	3 (21.43)	0.38	5 (26.32)	376 (7.99)	-0.02	638 (9.68)**
Firearms impounded	1 (2.86)	4 (3.25)	0 (0)	-0.2	2 (8.7)	1 (7.14)	0.21	2 (10.53)	142 (3.02)	0.01	202 (3.07)
Arrests	1 (2.86)	4 (3.25)	0 (0)	-0.2	1 (4.35)	1 (7.14)	0.21	1 (5.26)	144 (3.06)	0.01	173 (2.63)
Time in minutes from/to:											
Incoming call/dispatch	5.34 (13.14)	1.77 (5.67)	5.36 (2.66)	0.00	6.28 (10.98)*	1.23 (0.50)	-0.37	4.54 (10.76)	6.75 (23.74)	0.06	7.49 (28.00)*
Dispatch/ officer arriving	3.64 (2.45)	3.16 (2.85)	8.28 (5.89)*	1.19	5.09 (2.88)*	2.58 (0.63)	-0.50	2.58 (2.25)	5.34 (11.18)	0.15	4.64 (8.79)
Incoming call/ officer arriving	8.98 (13.81)	4.93 (6.57)	13.28 (6.26)	0.33	11.38 (11.71)**	3.81 (0.88)	-0.44	7.12 (12.41)	12.00 (28.42)	0.11	12.10 (31.57)*

**$p < 0.01$; *$p < 0.05$ based on χ^2 and *t*-tests; ES= Hedge's *g* effect size (negative effect size suggests higher likelihood in treatment area than comparison area); using study area as the reference category

Note: FireFly pretest period - 1/2/19 to 5/25/19; posttest period - 1/2/20 to 5/25/20.

Posttest. Exhibit 26 shows the bivariate comparisons between the study area and comparison areas after FireFly was deployed, posttest. Comparing the study area to control area 1, we found several large, statistically significant differences. Incidents occurring in the study area were significantly more likely than those in control area 1 to activate FireFly ($p < 0.01$; Hedge's g= -2.52), to result in an officer responding ($p < 0.01$; Hedge's g= -1.32), and to have a shorter time between a call being received and an officer arriving at the scene ($p < 0.01$; Hedge's g= 0.90). There were also medium and significant effect size differences in the time between a call being received and being dispatched ($p < 0.05$; Hedge's g= 0.72), and a call being dispatched and an officer arriving ($p < 0.05$; Hedge's g= 0.67). Although not statistically significant, there were also small effect size differences suggesting that incidents in the study area were more likely than those in control area 1 to result in an incident report (Hedge's g= -0.22), but less likely to result in an impounded firearm (Hedge's g= 0.27).

Comparing the study area to control area 2, we found large, statistically significant differences in the likelihood that an incident would activate FireFly ($p < 0.01$; Hedge's g= -2.06) and that it would result in an officer responding ($p < 0.01$; Hedge's g= -1.07). There were small but statistically insignificant differences between the areas in the likelihood that a firearm would be impounded (Hedge's g= 0.36), in the times between a call being received and dispatched (Hedge's g= 0.44), a call being dispatched and an officer arriving on scene (Hedge's g= -0.20), and a call being received and an officer arriving (Hedge's g= 0.30).

Finally, there were large, statistically significant differences between the study area and the remainder of the city. Incidents in the non-study area were significantly less likely to involve a FireFly activation ($p < 0.01$; Hedge's g= -3.66) and to result in an officer responding ($p < 0.01$; Hedge's g= -1.09). There were also statistically significant and medium effect size differences suggesting that incident reports were less likely to be created ($p < 0.01$; Hedge's g= -0.44) and casings were less likely to be impounded ($p < 0.01$; Hedge's g= -0.52) in the non-study area than in the study area. There were significant, although small differences in the times between a call being received and dispatched ($p < 0.05$; Hedge's g= 0.21) and between a call being received and an officer arriving ($p < 0.05$; Hedge's g= 0.23), with longer response times occurring outside of the study grids.

Exhibit 26. Posttest between-group bivariate comparisons (study to control areas)

	Study area (n=2 grids)		Control 1 area (n=2 grids)			Control 2 area (n=2 grids)			Non-study area (n=1501 grids)		
	Pretest # (%)	Posttest # (%)	Pretest # (%)	Posttest # (%)	Hedge's *g* # (%)	Pretest # (%)	Posttest # (%)	Hedge's *g* # (%)	Pretest # (%)	Posttest # (%)	Hedge's *g* # (%)
# incidents	35	123	14	23		14	19		4,704	6,589	
# FireFly activations	0 (0)	104 (84.55)	0 (0)	0 (0)**	-2.52	0 (0)	2 (10.53)**	-2.06	0 (0)	317 (4.81)**	-3.66
Officer responded	12 (34.29)	110 (89.43)	5 (35.71)	10 (43.48)**	-1.32	7 (50)	10 (52.63)**	-1.07	1,639 (34.84)	2,451 (37.20)**	-1.09
Incident report created	6 (17.14)	39 (31.71)	2 (14.29)	5 (21.74)	-0.22	3 (21.43)	7 (36.84)	0.11	636 (13.52)	1,022 (15.51)**	-0.44
Casing impounded	3 (8.57)	31 (25.2)	2 (14.29)	5 (21.74)	-0.08	3 (21.43)	5 (26.32)	0.03	376 (7.99)	638 (9.68)**	-0.52
Firearm impounded	1 (2.86)	4 (3.25)	0 (0)	2 (8.7)	0.27	1 (7.14)	2 (10.53)	0.36	142 (3.02)	202 (3.07)	-0.01
Arrest	1 (2.86)	4 (3.25)	0 (0)	1 (4.35)	0.06	1 (7.14)	1 (5.26)	0.11	144 (3.06)	173 (2.63)	-0.04
Time from call received to dispatched (mins.)	5.34 (13.14)	1.77 (5.67)	5.36 (2.66)	6.28 (10.98)*	0.72	1.23 (0.50)	4.54 (10.76)	0.44	6.75 (23.74)	7.49 (28.00)*	0.21
Time from call dispatched to officer arrived (mins.)	3.64 (2.45)	3.16 (2.85)	8.28 (5.89)*	5.09 (2.88)*	0.67	2.58 (0.63)	2.58 (2.25)	-0.20	5.34 (11.18)	4.64 (8.79)	0.17
Time from call received to officer arrived (mins.)	8.98 (13.81)	4.93 (6.57)	13.28 (6.26)	11.38 (11.71)**	0.90	3.81 (0.88)	7.12 (12.41)	0.30	12.00 (28.42)	12.10 (31.57)*	0.23

**p < 0.01; *p < 0.05 based on χ^2 and *t*-tests; ES= Hedge's *g* effect size (a negative effect size suggests a higher likelihood in the treatment area than the comparison area); using the study area as the reference category.

Note: Pretest period 1/2/19 to 5/25/19; posttest period 1/2/20 to 5/25/20

Due to some notable differences between the study and comparison areas prior to FireFly being deployed, we also used difference-in-difference models to compare the change that occurred from pretest to posttest within the study area to the change that occurred pretest to posttest in each of our control areas. This allowed us to determine whether those changes in the study area were significantly different from those changes in the control areas. Due to the low number of shots fired-related incidents during the study period, we again discuss our findings in terms of both statistical significance and the magnitude of the effects.

Exhibit 27 presents the difference-in-difference results for incident outcomes between the study area and each of our comparison areas. Officers were significantly more likely to respond to incidents that occurred in the study area than to incidents that occurred in control area 1 during the posttest ($p < 0.01$). This is a dramatic difference, suggesting that the likelihood of an officer responding to an incident in the study area during the posttest period was 1,071% higher than the likelihood of an officer responding to an incident in control area 1. Although there were no statistically significant differences between the study area and control area 1 in the remainder of the outcomes examined, several of the differences between the study area and control area 1 were relatively large in terms of magnitude. For instance, incidents that occurred in the study area were 35% more likely to result in the creation of an incident report and 116% more likely to result in a casing being impounded.

Notable differences also are seen between incidents that occurred in the study area and those that occurred in control area 2 during the posttest period. Incidents that occurred in the study area were 1,360% more likely to result in an officer responding, relative to incidents in control area 2 ($p < 0.01$). No other statistically significant posttest differences were found between incidents that occurred in the study area and control area 2, although a number of the findings are again notable in terms of magnitude. Incidents that occurred in the study area were 174% more likely to result in a casing being impounded and 58% more likely to result in an arrest than incidents that occurred in control area 2. Incidents in the study area, however, were 25% less likely to result in a firearm being impounded than those that occurred in control area 2.

Finally, relative to all grids in the non-study area, incidents that occurred in the study area after FireFly deployment were significantly more likely to result in an officer responding ($p < 0.01$), with a 1,364% greater likelihood of an officer responding to incidents that occurred in the study area. Although not statistically significant, incidents that occurred in the study area were 91% more likely to result in the creation of an incident report, 191% more likely to result in a casing being impounded, 12% more likely to result in a firearm being impounded, and 34% more likely to result in an arrest than incidents that occurred in the non-study area. (See exhibit 27.)

Exhibit 27. Difference-in-difference estimators predicting incident outcomes using logistic regression (odds-ratios)

	Control 1 area	Control 2 area	Non-study area
Officer responded	11.71** (9.81)	14.60** (12.30)	14.64** (6.78)
Incident report created	1.35 (1.40)	1.05 (0.99)	1.91 (0.94)
Casing impounded	2.16 (2.41)	2.74 (2.88)	2.91 (1.87)
Firearm impounded	1.00 (0.00)	0.75 (1.28)	1.12 (1.28)
Arrest	1.00 (0.00)	1.58 (2.93)	1.34 (1.53)

**$p < 0.01$, *$p < 0.05$
Note. Pretest is 1/2/19 to 5/25/19; posttest period is 1/2/20 to 5/25/20; exponentiated standard errors in parentheses.

We again used difference-in-difference analyses to examine whether FireFly influenced our measures of response time, as shown in exhibit 28. The results suggest that there were no statistically significant differences in the measures of response time between the study area and any of the control areas; however, there were notable effect size differences. Control area 1 results suggest that the time between a call being dispatched and an officer arriving on scene (g= -1.57) was shorter in the study area relative to control area 1, but the time between a call being received and an officer arriving was longer in the study area relative to control area 1 (g= -0.55). There were also some meaningful differences in response time between the study area and control area 2. Relative to the study area, incidents in control area 2 experienced longer waits between a call being received and dispatched (g= 0.60), the time between a call being dispatched and an officer arriving (g= 0.39), and the time between a call being received and an officer responding (g= 0.66). Finally, there were no statistically significant or substantively meaningful effect size differences in the measures of response time between incidents in all grids in the non-study area relative to the study area.

Exhibit 28. Difference-in-difference coefficients predicting response times using OLS

	Control area 1		Control area 2		Non-study area	
	β	Effect size	β	Effect size	β	Effect size
Time call received to dispatched (mins.)	-4.49 (4.16)	0.00	-6.88 (3.98)	0.60	-4.31 (7.94)	-0.05
Time from call dispatched to officer arrived (mins.)	2.71 (1.85)	-1.57	-0.48 (1.57)	0.39	0.21 (2.96)	-0.18
Time from call received to officer arrived (mins.)	-2.14 (4.91)	-0.55	-7.36 (4.51)	0.66	-4.15 (9.15)	-0.10

**$p < 0.01$, *$p < 0.05$
Note: Pretest 1/2/19 to 5/25/19; posttest 1/2/20 to 5/25/20; standard errors in parentheses.

Conclusions and Implications

This report provides a description and evaluation of the Phoenix Crime Gun Intelligence Center during its first two years. The evaluation team reviewed the Center's organizational structure and operation strategies, and examined data obtained from PPD's records management and impounded evidence systems, NIBIN and eTrace records, Maricopa County Attorney's Office records, and point-of-contact investigators' responses to our surveys. Having analyzed the results, we discuss our findings and major conclusions, the limitations of the present study, and our recommendations for the CGIC moving forward.

The CGIC was associated with increased ballistic evidence collection.

Using training videos and in-person sessions, PPD patrol officers were prepared for increasing the comprehensive collection of shell casings and crime guns from crime scenes. They were shown the value of recovering all ballistic evidence regardless of an incident's severity, and they acquired the skills and techniques needed to correctly impound ballistic evidence. The process data show that officers responded to substantially more incidents that produced recovered guns and ballistic evidence during both posttest periods than they had during the pretest period. As the number of incidents where casings were collected increased, the number of incidents where guns were recovered and the total number of recovered guns also increased. Continuing the enhanced trainings on the comprehensive collection of shell casings and crime guns is warranted; we recommend continuing to mandate the educational videos for all sworn officers, annually or biennially.

The CGIC was associated with increased NIBIN entries and NIBIN leads.

The number of NIBIN entries increased from 2,936, pretest, to 3,484, posttest year one, and 6,313, posttest year two. Pretest, only about 49% of eligible ballistic evidence was processed and entered; this compares to 58% in posttest year one and 98% in posttest year two. The increases in the number of entries, as expected, resulted in increases in the number of leads. Pretest, the PPD generated 175 leads, compared to 244 in posttest year one and 461 in posttest year two. These findings indicate that the comprehensive approach to ballistic evidence collection resulted in more effective intelligence gathering, in turn enabling the identification of a greater number of gun crimes that were linked to at least one other gun crime. To sustain these progressive outcomes, however, current staffing and resource levels will need to be maintained.

The CGIC was associated with increased coordination and cooperation, which resulted in the expedited entry of ballistic evidence.

For the PPD to strengthen its capabilities to preserve evidence integrity, meet the demand for expedited NIBIN entries of ballistic evidence, and provide prosecutors with high value evidence for use in court, the CGIC needed to develop and implement new and revised procedural policies and practices. To this end, PPD managers led a working group that included representatives from the MCAO and the Crime Lab. Analyzing official and survey data, we found that with the new CGIC policies and practices in place, time intervals between incidents and the NIBIN entry of their ballistic were significantly reduced. For example, pretest, that interval averaged 127 days; in posttest year two, it averaged 27 days. Moreover, pretest, about 3% of NIBIN entries were made within two days of an incident, while in posttest year two that percentage increased to 32%.

The CGIC was associated with investigators perceiving leads to be more helpful in their investigations.

Investigators surveyed reported that NIBIN leads received posttest were more likely to have been helpful that those received pretest. They indicated that the posttest leads had been helpful with identifying a specific group as likely suspects, identifying at least one suspect, interrogating suspects, arresting suspects, and case processing (i.e., charging, convicting, sentencing). Most likely, this was a consequence of new CGIC processes that increased the speed with which leads were being provided to investigators, as timeliness was positively and significantly related to investigators who perceived the leads as helpful. The investigators who rated leads as helpful reported receiving lead notifications in an average of 117 days after an incident (median 22 days) compared to an average of 418 days (median 345 days) for those who rated the NIBIN leads as unhelpful.

The CGIC was associated with higher clearance rates.

Difference-in-difference estimates using police data showed that the CGIC was associated with clearance rates. For example, while NIBIN lead-related clearance rates increased from 21% to 33% between the pretest year and the first year of the CGIC's operation, non-NIBIN case clearance rates increased only 4% (from 49% to 53%) between these periods. Change was most pronounced for offense types such as homicide, aggravated assault, and discharging a firearm. The higher posttest clearance rates produced by the CGIC are meaningful, especially given the violent nature of the offenses. Such evaluation findings would be useful to include in the education of patrol officers and investigators responding to violent offenses, emphasizing the contributions of ballistic evidence collection and other CGIC practices.

Gun crime clearance rates for NIBIN-related incidents were still marginal, however; for example, in posttest year two, the aggravated assault clearance rate was 38%. Deploying data-driven strategies, such as problem-oriented policing and targeting high use guns and chronic gun offenders, would be most likely to leverage and build upon the gains produced by the CGIC.

The CGIC was not associated with a positive change in prosecutorial outcomes.

The CGIC and the vertical prosecution strategy employed by the County Attorney's Office did not immediately result in a higher proportion of arrests being charged by the attorney or in higher conviction rates, according to our analysis of court data. A limitation of the current evaluation, however, has been its duration; the posttest period lasted only two years. A number of cases opened during the study period were still open as the study ended, and thus their dispositions could not be included in our analyses: 558 cases from the pretest year, 1,229 cases from posttest period one, and 2,744 cases from posttest period two were eliminated from the analysis for this reason. The MCAO, a recent recipient of BJA CGIC funding, might consider allocating funds to examine how these findings change once the dispositions of these cases are known.

The use of e-Trace did not improve with the implementation of the CGIC.

The CGIC did not strongly promote ATF's eTrace, and its use to trace firearms did not produce a steady improvement in related outcomes over the study period. Specifically, the percentage of firearms traced through eTrace declined from pretest to posttest year one. The percentage of firearms traced to a purchaser did show some increase, from 78% pretest to 84% in both posttest years. In the near future, the CGIC might consider establishing a supply-side task force to review eTrace findings and to determine their potential usefulness as part of a problem-oriented approach to reducing gun violence.

A pilot test of PPD's acoustic gunshot detection system (FireFly) demonstrated its potential effectiveness.

FireFly captured a majority of gunshots occurring in the study area; our findings suggest that its effective range may be even somewhat larger than expected. Events captured outside the study area were not consistently reviewed by dispatchers, resulting in some but not all of them being forwarded to patrol officers as calls-for-service; therefore, only those incidents that occurred within the study area experienced the full FireFly implementation protocol. Despite the fact that the pilot test was limited by the number of communities examined, the onset of COVID and associated community changes, and the small number of shots fired-related crime incidents in the targeted area, our findings indicated that the use of FireFly produced a number of positive outcomes: Patrol officers were more likely to respond to gunshots and responded more quickly, incident reports were more likely to be filed, and more casings were impounded from the study area. Finally, arrests increased in the study area when compared to control area 2 and all other non-study grids (other than control area 1).

For example, incidents that occurred in the study area were 91% more likely to have an incident report filed, 191% more likely to result in a casing being impounded, and 34% more likely to result in an arrest than were incidents occurring in the non-study areas. These findings provide preliminary support for FireFly, indicating its potential effectiveness as an acoustic gunshot detection system. For the system to be confirmed as effective, however, further examination involving the use of a more rigorous evaluation design would be required.

Limitations

Before the interpretation of findings is complete, we present the limitations to the present study. First, the evaluation is limited by our research design. We employed a pretest-posttest nonequivalent comparison group(s) design, which contained a number of threats to internal validity (e.g., history, testing, maturation, selection bias). Second, our research was limited to Phoenix, and our findings should not be generalized to other communities. Third, the Phoenix Police Department does not have an official, or informal, definition of gun crime, and the agency does not have any mechanism to identify and count gun crimes. The present study used a number of strategies to identify gun crimes in Phoenix, but this definitional problem is a threat to internal and external validity. Fourth, with respect to FireFly, our sample size was small and the duration of exposure to the treatment was limited. Increased statistical power and a more sophisticated research design is necessary to more fully understand the effectiveness of the technology. Last, our results could be affected by multiple treatment interference. Other federally sponsored responses to guns and gun crime, such as Project Safe Neighborhoods, were operational in Phoenix during the study period, and that could have affected the validity of results.

Recommendations

The Phoenix Police Department has made enormous strides in responding to gun crime over the past two years. The establishment and implementation of the CGIC in this short amount of time has been a major achievement. Additional training has resulted in enhanced expectations of patrol officers, substantially more ballistic evidence being collected, and crime gun evidence being processed largely within the two-day recommended timeframe. In addition, clearance rates for incidents with leads has significantly increased. The recommendations below are intended to fill in some gaps, and we believe they would benefit the PPD as it moves forward in its response to gun crime.

1. The PPD should create a policy that defines gun crime and mandates data collection processes that allow for the tracking and analysis of gun crimes by crime analysts. Systematic processes are needed to ensure this information is accurately and routinely collected for future reporting. ASU's CVPCS is interested in collaborating with PPD on this policy's development and the implementation of the data collection process.
2. The PPD should establish and maintain a database that links gun crime data (as noted in Recommendation #1) with its NIBIN and eTrace data. These data should be reviewed and analyzed for the purpose of preventing, intervening in and suppressing gun violence. A number of innovative and evidence-based responses rely on understanding the people, places and events that drive gun crime in order to develop and implement targeted responses. ASU's CVPCS is willing to collaborate with PPD on the establishment, maintenance and interpretation of results from such a database.
3. The PPD should consider providing additional organizational resources to the investigation of gun crimes perpetrated by high use guns (i.e., incidents involving a gun that has been linked to other gun-related incidents). While such incidents provide more ballistic evidence, they have lower clearance rates than similar types of crime, and they present a more serious threat to the community. A lower caseload might be necessary in order for investigators to dedicate additional time and resources to the investigation of these crimes.
4. The PPD should consider instituting shooting reviews, the purpose of which would be to bring together individuals from the CGIU, other investigative units, and others who are responsible for responding to fatal and nonfatal shootings, giving them a place to share intelligence related to shootings and to assign responsibility for collecting further intelligence for investigative purposes. They would present opportunities to collectively identify trends and develop responses. The reviews could foster a culture of communication and accountability in all matters related to shootings. (For additional information about variations on this approach, see work done in Oakland (https://policingequity.org/images/pdfs-doc/reports/A-Case-Study-in-Hope.pdf), Philadelphia (https://www.phila.gov/2020-10-05-10-things-the-city-is-doing-right-now-to-

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Appendix A

Impact Evaluation: Supplemental FireFly Methods and Results

The study area consisted of the two PPD map grids that experienced the highest number of shots-fired-related calls for service in the year preceding FireFly deployment. Control grids were selected using k-nearest neighbor analysis to identify the map grids that were the most similar to the treatment grids in terms of calls for service, indicators of socioeconomic status, racial/ethnic population distributions, and the residential population. The two pairs of grids that were the most similar to the study grids were selected for comparison. Although the control grids were selected to closely approximate the study grids, it is important to note that the study area experienced the most shots-fired-related gun crime, which could render the control grids as imperfect comparison sites.

Exhibit A.1. Descriptive statistics - supplemental FireFly methods and results

	Study area (n=2 grids)	Control 1 (n=2 grids)	Control 2 (n=2 grids)	Non-study areas (n=1501 grids)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
CFS 1/1/18 - 10/31/18 (#)	69.00 (32.53)	58.00 (15.56)	27.00 (1.41)	16.37 (19.98)
Poverty (%)	0.32 (0.00)	0.14 (0.00)	0.28 (0.00)	0.17 (0.15)
Unemployment over 16 years old (%)	0.04 (0.00)	0.06 (0.00)	0.08 (0.00)	0.05 (0.03)
Households receiving public assistance (%)	0.09 (0.00)	0.02 (0.00)	0.03 (0.00)	0.02 (0.03)
Population mobility (%)	0.68 (0.00)	0.50 (0.00)	0.41 (0.00)	0.50 (0.18)
Female-headed households w/ children (%)	0.36 (0.00)	0.22 (0.00)	0.17 (0.00)	0.10 (0.08)
Foreign born (%)	0.19 (0.00)	0.21 (0.00)	0.23 (0.00)	0.17 (0.10)
Hispanic (%)	0.62 (0.00)	0.45 (0.00)	0.61 (0.00)	0.36 (0.28)
Black (%)	0.30 (0.00)	0.25 (0.00)	0.22 (0.00)	0.06 (0.07)
Total population	5,313.04 (1.08)	4,644.17 (7.50)	3,709.61 (0.50)	1,781.26 (806.98)
Population density	10,639.04 (17.00)	9,085.73 (8.45)	7,419.86 (0.15)	4,316.01 (3,518.95)

Note: SD = standard deviation

Appendix B

Investigator Survey Descriptive Statistics

To better understand how CIGC policies and practices were being used and perceived by investigators throughout the department who served as the point of contact for investigating incidents with NIBIN leads, the PPD, assisted by the research partners, invited them to participate in a survey; their participation was voluntary. Each survey form designated a specific CGIC case to think about when answering questions. Exhibit B.1 is a statistical description of their collective responses.

Exhibit B.1. Descriptive statistics - investigator survey responses

	Pretest (n=104)		Posttest 1 (n=152)				Posttest 2 (n=220)				Total (n=477)	
	#	%	#	%	$\chi 2$ / t	ES	#	%	$\chi 2$ / t	ES	#	%
Type of Criminal Case					21.33**	-0.52			32.36**	-0.57		
Assault	64	61.54	63	41.45			85	38.64			212	44.44
Drive-by-shooting/shooting at building	27	25.96	32	21.05			38	17.27			97	20.34
Robbery	3	2.88	23	15.13			25	11.36			51	10.69
Homicide	5	4.81	20	13.16			21	9.55			46	9.64
Prohibited possessor in possession	4	3.85	13	8.55			40	18.18			58	12.16
Other (attempted homicide, home invasion, kidnapping)	1	0.96	1	0.66			11	5			13	2.73
Year of crime					115.60**	-0.65			244.05**	-1.05		
2003	1	0.96	0	0.00			0	0.00			1	0.21
2004	0	0.00	1	0.66			0	0.00			1	0.21
2005	4	3.85	0	0.00			0	0.00			4	0.84
2006	1	0.96	0	0.00			0	0.00			1	0.21
2007	0	0.00	0	0.00			3	1.36			3	0.63
2008	0	0.00	1	0.66			0	0.00			1	0.21
2009	0	0.00	0	0.00			1	0.45			1	0.21

Exhibit B.1. Descriptive statistics - investigator survey responses

	Pretest (n=104)		Posttest 1 (n=152)				Posttest 2 (n=220)				Total (n=477)	
	#	%	#	%	χ2 / t	ES	#	%	χ2 / t	ES	#	%
2010	0	0.00	1	0.66			1	0.45			2	0.42
2011	0	0.00	0	0.00			1	0.45			1	0.21
2012	0	0.00	3	1.97			3	1.36			6	1.26
2013	2	1.92	1	0.66			1	0.45			4	0.84
2014	2	1.92	1	0.66			0	0.00			3	0.63
2015	9	8.65	4	2.63			2	0.91			15	3.14
2016	40	38.46	6	3.95			5	2.27			51	10.69
2017	45	43.27	54	35.53			14	6.36			114	23.9
2018	0	0.00	77	50.66			73	33.18			152	31.87
2019	0	0.00	1	0.66			114	51.82			115	24.11
Missing	0	0.00	2	1.32			2	0.91			2	0.51
Mean	2015.61		2017.09				2017.79				2016.94	
Detective assignment at time of crime					17.62*	-0.26			32.07**	-0.17		
Assaults	58	55.77	65	42.76			89	40.45			212	44.44
Homicide	6	5.77	19	12.50			28	12.73			54	11.32
Robbery	2	1.92	17	11.18			15	11.11			34	7.13
CGIC	5	4.81	15	9.87			48	21.82			68	14.26
Patrol	7	6.73	8	5.26			5	2.27			20	4.19
Gangs	4	3.85	6	3.95			2	0.91			12	2.52
Other	5	4.81	2	1.32			11	5.00			18	3.77
Missing	17	16.35	20	13.16			22	10.00			59	12.37
NIBIN Lead notification received?					16.14**	-0.09			24.87**	-0.03		
Yes	24	23.08	68	44.74			111	50.45			203	42.56
Not sure	43	41.35	54	35.53			61	27.73			158	33.12
No	36	34.62	27	17.76			42	19.09			105	22.01
Missing	1	0.96	3	1.97			6	2.73			11	2.31

Exhibit B.1. Descriptive statistics - investigator survey responses

	Pretest (n=104)		Posttest 1 (n=152)				Posttest 2 (n=220)				Total (n=477)	
	#	%	#	%	χ2 / t	ES	#	%	χ2 / t	ES	#	%
From whom did you receive the Lead?					16.02*	0.20			33.25**	0.17		
CGIC	3	12.50	24	35.29			54	48.65			81	39.9
NIBIN	4	16.67	5	7.35			11	9.91			20	9.85
Co-worker	0	0.00	8	11.76			10	9.01			18	8.87
ATF	5	20.83	3	4.41			2	1.80			10	4.93
Supervisor	3	12.50	3	4.41			2	1.80			8	3.94
RMS	0	0.00	2	2.94			8	7.21			10	4.93
Other agency	0	0.00	1	1.47			1	0.90			2	0.99
Missing	9	37.50	22	32.35			23	20.72			54	26.6
How did you receive the Lead notification?					10.45*	0.07			25.65**	0.61		
Email	13	54.17	34	50.00			21	18.92			68	33.50
Case management	2	8.33	11	16.18			44	39.64			57	28.08
In-person	2	8.33	4	5.88			25	22.52			31	15.27
Phone	1	4.17	6	8.82			12	10.81			19	9.36
Mail/letter	2	8.33	0	0.00			1	0.90			3	1.48
CGIU detective	1	4.17	0	0.00			1	0.90			2	0.99
Missing	3	12.50	13	19.12			7	6.31			23	11.33

**$p < 0.01$; *$p < 0.05$ based on χ^2 test using pre-CGIC as the reference category; ES= Hedge's *g* effect size

Appendix C.

Success Stories

NIBIN Case Example #1: "Medical Boot" Series Shootings Investigation (2019)

On March 9, 2019, Phoenix Police Department (PPD) officers responded to a drive-by shooting/shooting at an occupied structure. While on the scene, officers collected five 7.62 cartridge casings and five .40 cartridge casings. The victim of the drive-by believed that the suspect's vehicle was a black sedan and that the suspect may have been a juvenile.

On March 29, officers were dispatched to a shots fired/unlawful discharge call. The unknown suspect had fired shots behind a residence, resulting in no injuries or damage. While on the scene, officers located several .40 cartridge casings.

On April 2, PPD officers responded to another shots fired/unlawful discharge. Again, an unknown suspect had fired shots, resulting in no injuries or damage. An officer on the scene collected one .40 cartridge casing.

On April 12, officers responded to yet another shots fired/unlawful discharge. Once again, an unknown suspect had fired shots that had resulted in no injuries or damage. However, witnesses to this crime claimed that they had heard two volleys of 4-5 shots each and saw a white Jeep Commander followed by a grey Dodge Caliber. While on the scene, officers collected three .40 cartridge casings.

On April 15, a NIBIN lead that linked all four incidents was assigned to a CGIU Detective/ATF Task Force Officer. In initiating the NIBIN investigation, the detective on the case recanvased the first four crime scenes, finding surveillance video from three of the incidents that showed a male juvenile wearing a medical boot on his right foot exiting from a silver sedan and shooting a handgun into the air. However, no additional evidence or information promoting solvency was found.

On May 14, PPD officers were dispatched to an aggravated assault/drive-by shooting. An unknown male suspect had shot at two victims after a verbal altercation, damaging a vehicle but resulting in no injuries. The suspect left in a possible Lexus SUV with Kansas plates and tinted windows. On the scene, officers collected two .40 cartridge casings that subsequently correlated back to the previous four incidents.

Based on this correlation, CGIU detectives and ATF special agents initiated concentrated surveillance in the areas of known incidents, resulting in a report of a stolen Lexus SUV with Kansas plates within the area of the shootings. Through targeted surveillance on the stolen vehicle, on May 17 a juvenile male was observed entering the stolen Lexus and driving to a residence where he was seen limping on his right leg. After observing the suspect exit the residence and drive around in a white Dodge truck, securing surveillance video from the fifth incident showing what appeared to be the same Lexus SUV driven by the suspect, and obtaining information from the Chandler Police Department indicating that the suspect had been issued a boot after a vehicle collision while fleeing from the police in the beginning of March, the investigators were issued a search warrant that was served by CGIU and ATF at the suspect's residence. The suspect was apprehended on May 17.

Through the warrant, detectives uncovered the suspect's cellphone with a lock screen photo of a .40 caliber Taurus Millennium, a blue hoodie sweatshirt matching incident three, a loaded .40 caliber Taurus Millennium semi-auto handgun with a defaced serial number, numerous sets of car keys matching suspect vehicle types described in previous related incidents, a medical boot, and a .40 shell casing. The suspect was positively identified in a photographic line-up by the victim in the fifth incident. The firearm recovered from the suspect's bedroom was test fired and correlated back to all five shootings. The suspect was detained as a juvenile and later remanded as an adult to Maricopa County Superior Court.

NIBIN Case Example #2: Summer Bell Brown Homicide Investigation (2019)

Just before 6:00 pm on April 3, 2019, Phoenix Police Department officers responded to the homicide of 10-year-old Summer Brown. In an apparent road rage incident, a suspect in a pickup truck followed a vehicle driven by Summer's father, Dharquintium Brown, after Mr. Brown had apparently cut the suspect off on the highway. Once in the driveway of the Brown home, the suspect began firing shots at the family's home and vehicle, leaving Mr. Brown with non-life-threatening injuries and Summer Brown mortally wounded. Roughly two hours later, the Homicide unit requested that the CGIU respond to the original scene to collect shell casings. Upon arriving on the scene, the CGIU assumed custody of several shell casings and began an expedited entry into NIBIN, with this entry resulting in no correlation hits.

The next day, a Silent Witness Tip led to the surveillance and eventual apprehension of a suspect involved in the shooting. After the issuance of a warrant, a firearm with several casings were found in a garbage can at the suspect's address. CGIU detectives responded to the scene to take custody of this evidence for immediate processing at 11:00 pm. At midnight on April 5, CGIU detectives swabbed and test fired the firearm, and entered it into NIBIN. Based on a preliminary correlation, the firearm was deemed a high probability match to the firearm used in the murder of Summer Brown. CGIU detectives interviewed the suspect and learned valuable information about additional investigations that would be linked through NIBIN the following day, and the suspect admitted owning the firearm components found in his residence and building/manufacturing firearms. Upon the issuance of a second warrant, several more firearms, a modified fully automatic rifle, multiple components used to convert firearms into fully automatic weapons, shell casings, and a large amount of additional components were recovered at the suspect's house.

On April 8, after entering the new evidence into NIBIN, CGIU detectives obtained copies of handwritten receipts for the purchase/selling of several firearms. An ATF special agent then conducted eTraces on all firearms, receipts and firearm serial numbers found at the suspect's residence. This led to four NIBIN leads. First, one casing found in the trash at the suspect's address correlated to a scene casing of an attempted homicide incident from six months prior. Second, another casing found in the trash at the suspect's residence linked back to an armed robbery that was believed to have been carried out with guns sold by the suspect. An hour after uncovering this Lead, CGIU detectives learned that the suspect had been arrested for DUI and MIW by the Arizona Department of Public Safety (DPS) approximately four hours after the attempted homicide incident correlated in the first NIBIN lead. DPS confirmed that they had impounded five firearms and turned them over to CGIU for NIBIN entry. On April 9, this led to two additional NIBIN leads: first, a preliminary NIBIN correlation determined one of the firearms collected during the DPS DUI arrest was a likely match to the attempted homicide, and second, another firearm recovered in the DPS DUI arrest linked back to a robbery/home invasion incident.

NIBIN Case Example #3: Homicide Investigation (2019)

On November 5, 2019, just before midnight, PPD officers responded to a call of a shooting, where at the scene they found a victim shot to death in the street in front of his residence. During their time on the scene, Homicide detectives found two .40 caliber shell casings near the victim's body, representing their only leads. They asked a CGIU detective to respond to the scene to collect the shell casings. These casings were then entered into NIBIN, and a request was made to the correlation center for an expedited examination of the entries. At roughly 9:30 the next morning, the crime scene casings were correlated to another NIBIN lead. This lead was associated with two open Phoenix Police cases: an aggravated assault drive-by shooting and an armed robbery shooting committed by a known suspect (Suspect #1) who had stolen the victim's gun during the robbery.

Given these leads, Homicide and CGIU initiated a joint investigation effort, and CGIU was given permission by Robbery to assume the armed robbery shooting investigation. Through intelligence gathering, CGIU detectives learned that Suspect #1 had been dropped off at a hospital with a gunshot wound after the homicide occurred on November 5. Suspect #1 and the male (Suspect #2) who dropped him off at the hospital both told responding patrol officers that they had been shot at during a drug deal. Both were released from custody, and Suspect #1 was admitted to the hospital with a shattered pelvis. CGIU detectives then met with the robbery victim of the associated NIBIN lead and obtained probable cause to arrest Suspect #1 for committing the armed robbery. CGIU detectives also discovered that Suspect #1 had used Snapchat to set up the robbery. The detectives contacted the Homicide case agent and suggested that they examine the homicide victim's phone for Snapchat content. When examined, the victim's Snapchat revealed that he had been in communication with Suspect #2 just prior to the homicide. This led to detectives being issued search warrants for the residences of both Suspect #1 and Suspect #2 and beginning surveillance.

On November 7, CGIU and homicide detectives interviewed Suspect #1 at the hospital. Upon arriving at the hospital, they located the car of Suspect #1 in the parking lot. A bullet strike was observed in the driver's door, Leading detectives to transport the vehicle to the crime lab. Suspect #2 was located and arrested by tactical support personnel, and Suspect #1 was arrested by a CGIU detective as he was being released from the hospital. With search warrants in hand, CGIU and Homicide detectives found a firearm matching the caliber of the NIBIN lead in the bedroom of Suspect #1. Further, a firearm matching the description of the gun stolen from the armed robbery victim was located in the residence of Suspect #2. Thereafter, interviews with both suspects were conducted by CGIU and Homicide detectives, during which Suspect #1 admitted to possessing the firearm and to committing the first armed robbery, and Suspect #2 admitted that he went with Suspect #1 to rob the homicide victim and stated that Suspect #1 had shot and killed the victim. Suspect #2 also admitted that Suspect #1 had provided him with the gun from the previous robbery and stated that he had carried it during the recent homicide/robbery.

Based on the expedited processing of the firearms found during the search of both suspects' residences, the CGIU was able to correlate the gun found in Suspect #1's bedroom to the NIBIN lead associated with the two open Phoenix Police cases through direct comparison, which revealed a match. Further, Suspect #1 admitted to his mother in a monitored interview room that he had robbed and shot and killed the victim. On November 8, both suspects were booked into jail for first-degree murder and multiple counts of armed robbery.