MONITORING HIGH-RISK GANG OFFENDERS WITH GPS TECHNOLOGY: AN EVALUATION OF THE CALIFORNIA SUPERVISION PROGRAM

FINAL REPORT

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Abstract

Despite the overall decline in violent crime nationally, gang violence rates throughout the country have continued at exceptional levels over the past decade. Therefore, it is vital for parole departments to have effective tools for maintaining public safety. The purpose of this evaluation is to determine the effectiveness of global positioning system (GPS) monitoring of high-risk gang offenders (HRGOs) who are released onto parole.

This study integrates outcome, cost, and process evaluation components. The outcome component assesses the impact of the California Department of Corrections and Rehabilitation's Division of Adult Parole Operations (DAPO) GPS supervision program by employing a nonequivalent-group quasi-experimental design, with a multilevel discrete-time survival model. A propensity score matching procedure is used to account for differences between the treatment and comparison groups. The study population is drawn from all HRGOs released from prison between March 2006 and October 2009 in six specialized gang parole units in the State of California. The final sample includes 784 subjects equally divided between the treatment and control groups. The treatment group consists of HRGOs who were placed on GPS monitoring, and the control group consists of matched gang offenders with a similar background. The resulting sample shows no significant differences between the groups in any of the propensity score matching variables.

The effectiveness of the program is assessed using an intent-to-treat (known as ITT) approach, with two main outcomes of interest: compliance and recidivism. Compliance is measured through parole violations; recidivism is assessed using rearrests and rearrests for violent offenses. Each outcome is assessed with a survival analysis of discrete-time recidivism data, using a random intercept complementary log–log model. In addition, frailty modeling is used to account for the clustering of parolees within parole districts.

The findings indicate that during the two-year study period, subjects in the GPS group, while less likely than their control counterparts to be arrested in general or for a violent offense, were much more likely to violate their parole with technical and nontechnical violations. Descriptive statistics and summary analysis revealed more GPS parolees were returned to custody during the study period. These results will be studied further in a forthcoming follow-up report.

The cost analysis indicates the GPS program costs approximately $21.20 per day per parolee, while the cost of traditional supervision is $7.20 per day per parolee—a difference of $14. However, while the results favor the GPS group in terms of recidivism, GPS monitoring also significantly increased parole violations. In other words, the GPS monitoring program is more expensive, but may be more effective in detecting parole violations.

Finally, the process evaluation reveals the GPS program was implemented with a high degree of fidelity across the four dimensions examined: adherence, exposure, quality of program delivery, and program differentiation.

Contents

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It was a privilege to work with CDCR, attend the GPS training, and watch the program in action, and to be able to apply the science and tools of evaluation on such a strong program.

— Stephen V. Gies, Principal Investigator
Randy Gainey, Co–Investigator

Executive Summary

Highlights

Purpose: The purpose of this evaluation is to determine the effectiveness of the global positioning system (GPS) monitoring of high-risk gang offenders (HRGOs) who are placed on parole.

Design: This study integrates both outcome and process evaluation components. The outcome component assesses the impact of the California Department of Corrections and Rehabilitation (CDCR) GPS supervision program by employing a nonequivalent-group quasi-experimental design with a multilevel survival model. In addition, a propensity score matching procedure was used to account for the differences between the treatment and comparison groups.

Outcomes: This study provides evidence that GPS is an effective suppression tool to remove individual gang members from the community. The odds of a technical violation are 36 percent greater among the GPS group, while the odds of a nontechnical violation are 20 percent greater. Conversely, the GPS group is less likely to be rearrested overall (the chance of being rearrested is 26 percent lower) and for violent crimes (32 percent lower).

Cost: The cost of the GPS program is roughly $14.00 per day per parolee more expensive than traditional supervision. However, the outcome results favored the GPS group. In other words, the GPS monitoring program is more expensive but more effective.

Fidelity: The GPS program was implemented with a high degree of fidelity.

Purpose

Los Angeles has been dubbed by some as the "the gang capital of the world" (The Advancement Project 2007, p. 1). However, gangs in California are not limited to the City of Los Angeles. There are roughly 250,000 members statewide in 336 different gangs (NGTA 2011). Although these street gangs are typically not highly organized (Howell 2012), the individual members are involved in a host of violent criminal activities, including assault, drug trafficking, extortion, firearms offenses, home invasion robberies, homicide, intimidation, shootings, and weapons trafficking. In fact, a recent analysis conducted by the National Gang Intelligence Center indicates gang members are responsible for an average of 48 percent of violent crime in most jurisdictions, and for a much greater percentage of violent crime in jurisdictions like California with a large concentration of gang members, where it is estimated that gangs are responsible for at least 90 percent of crime (NGTA 2011).

Consequently, street gang activity and the criminal justice response in California and other jurisdictions throughout the United States remain important and significant inquiries. One response in California has been to use Global Positioning System (GPS) monitoring of high-risk gang offenders* (HRGOs) who are placed on parole. The purpose of this evaluation is to determine the effectiveness of this strategy.

Study Goals and Objectives

The overall purpose of this study is to conduct a quasi-experimental evaluation of the California Department of Corrections and Rehabilitation (CDCR) GPS monitoring program of HRGOs. Specifically, the goals of this study are to

- Assess the fidelity of the program.
- Assess the cost of the GPS program.
- Assess the effectiveness of the GPS program for gang offenders.

Objectives

To meet these goals, this project has set several highly specific objectives to measure the success of each goal. The specific objectives of the project organized by goal are as follows:

* In this report, the term gang offender refers to an individual identified as either a prison or criminal street gang member. See page 1-13 for more details.

1. Assess the Fidelity of the GPS Program.

- Determine the program adherence to all core components (i.e., program staffing qualifications, caseload restrictions, parolee orientation specifications, and parole supervision specifications).
- Determine the degree to which the prescribed level of program exposure was obtained.
- Determine the quality of program delivery (e.g., skill of the staff in using techniques or methods prescribed by the program and preparedness or attitude of staff toward the program).
- Determine the degree to which program components were reliably differentiated from one another.

2. Assess the Cost of the Program.

- Determine the cost of monitoring HRGOs with the GPS system.
- Determine the cost of monitoring HRGOs without the GPS system.

3. Assess the Effectiveness of the GPS Program for Gang Offenders.

- Determine the effect of GPS monitoring on offenders' subsequent occurrence of noncompliance with parole conditions (i.e., technical violation and nontechnical violation).
- Determine the effect of GPS monitoring on offenders' subsequent *occurrence* of criminal behavior (i.e., rearrest for any offense and rearrest for a violent offense).

DATA AND METHODOLOGY

To accomplish our goals and objectives, this study integrates both outcome and process evaluation components. The outcome component assesses the impact of the CDCR GPS supervision program by employing a nonequivalent-group quasi-experimental design with a multilevel survival model. We also use a propensity score matching procedure to account for the differences between the treatment and comparison groups. The study population is drawn from HRGOs (as determined by the GPS Monitoring Gang Eligibility Assessment Criteria Form) who are released from prison and residing in the State of California. The effectiveness of the program is assessed using an intent-to-treat (known as ITT) approach, with two main outcomes of interest: noncompliance and recidivism. Noncompliance is operationalized as a violation of parole. Recidivism, on the other hand, is operationalized as an arrest for a new crime. Each outcome is assessed with a survival analysis of discrete-time data, using a random intercept complementary log–log model. In addition, frailty modeling is used to account for the clustering of parolees within parole districts. The outcome component also includes a cost-effectiveness analysis of each outcome. The process component (see chapter 4) uses both quantitative and qualitative methods to provide a rich context to the program treatment and structure and to assess program fidelity (i.e., whether the program was designed well and implemented as intended).

PARTICIPANTS

This study focuses on HRGOs who are released from prison and placed on parole supervision with GPS monitoring in six California jurisdictions. This group (N=407) includes all HRGOs placed on GPS monitoring technology from March 2006 through October 2009 in each of the six specialized gang units located in the City of Los Angeles and the following California counties: Fresno, Los Angeles, Riverside, Sacramento, and San Bernardino. To identify comparison individuals likely to have pretreatment risk characteristics similar to those in the treatment group, a propensity score procedure was performed using a sample of offenders drawn from each of the same six communities that maintained specialized gang units, but who were not placed on GPS at the time of data collection. The initial sample included more than 145,000 subjects. The matching procedure resulted in a final sample of 784 subjects (392 treatment* and 392 control subjects). The two groups did not significantly differ on any variable.

DATA SOURCES

We used six primary sources to collect data: 1) the CDCR data management system, 2) official arrest records, 3) parole supervision records, 4) GPS monitoring data, 5) a CDCR parole agent (PA) survey, and 6) CDCR cost information.

California operates a data management system that houses numerous databases relevant to the supervision of HRGO parolees. The majority of data used for this study were derived from three databases: Cal–Parole, the Revocation Scheduling and Tracking System (RSTS), and the Offender-Based Information System (OBIS). A central feature of the California system is that offenders are linked across all of these systems through a unique identifier that permits users to identify the same individual in different contexts or data systems.

Another principal data source for this study was the official record of arrests, convictions, and custody (commonly known as a RAP sheet) of each study subject. These data were provided in a hardcopy format and coded by hand into a database developed specifically for the study.

A third data source included the record of supervision for each parolee. Specifically, the parole agent notes the date and the specific type of contact. These data were collected to measure the level of supervision received by each offender and to assess the California GPS program model.

The fourth data source was the GPS monitoring data from the two vendors: Satellite Tracking of People (or STOP) LLC and Pro Tech. These data were used for descriptive purposes and to assess the California GPS program model. Each vendor provided the following data: a profile of the offender; a record of each event (inclusion/exclusion zone, strap tamper, low battery, cell communication gap, and no GPS communication) that includes the event start and stop times and duration during a specified period; and the assignment history of the device.

A survey instrument was also developed to collect process data from CDCR parole agents. The final version contained questions in seven areas: 1) program staffing, 2) agent information, 3) equipment issues, 4) caseload specifications, 5) enrollment and orientation, 6) collaborative engagement, and 7) general summary.

* The treatment group was slightly reduced (15 subjects) because there was no admit status in the data.

The final category of data was cost information. The primary sources for such data were written reports, observations, and interviews. To facilitate the identification and specification of each cost, all expenditure items were divided into four broad categories that have common properties: 1) personnel (all fulltime and parttime staff and consultants), 2) facilities (i.e., the physical space required for the program), 3) equipment and materials (furnishings, instructional equipment, etc.), and 4) other inputs (all other costs that do not fit the other categories).

RESULTS

1. Assess the Fidelity of the GPS Program.

This study provides evidence regarding the degree to which the program services were delivered as designed. Overall the process evaluation reveals the GPS program was implemented with a high degree of fidelity across the four dimensions examined: *adherence*, *exposure, quality of program delivery,* and *program differentiation*. A summary of each dimension is provided below:

Adherence refers to whether the program service or intervention is being delivered as it was designed. In this case, the program was composed of five core components: program staffing requirements, caseload restrictions, HRGO parolee screening, parolee enrollment and orientation specifications, and parole supervision specifications. The findings demonstrate that while there was some variation across districts, the overall program fidelity was high in terms of adherence to program staffing requirements, caseload specifications, parolee orientation, GPS supervision, and field supervision.

Exposure refers to the measured quantity of a program. However, unlike the California GPS program for sex offenders, where each subject is required to be continuously monitored by GPS (i.e., 365 days), there is no prescribed GPS dosage level for the offenders in the gang program, resulting in a wide variation in the number of days offenders are placed under GPS supervision (GPS supervision days ranged from 0 to 727). Consequently, dosage, while relevant for understanding the operation of the program, is not applicable as a measure of fidelity in this study.

Quality of program delivery is the manner in which a teacher, volunteer, or staff member delivers a program (e.g., skill in using the techniques or methods prescribed by the program, enthusiasm, preparedness, or attitude). Overall, these findings suggest that in terms of quality of delivery, the GPS program was delivered with proficient skill and a positive attitude.

Program differentiation identifies the unique features of different components or programs that are reliably differentiated from one another. The single difference between traditional parole supervision and GPS supervision is the use of GPS technology as a monitoring tool. The findings indicate that the significant difference between the groups in terms of GPS monitoring shows that the GPS program is visibly differentiated from traditional parole supervision.

2. Assess the Effectiveness of the GPS Program.

The GPS and control groups were well matched in this study after the use of propensity score adjustments for numerous pretreatment characteristics. At baseline, mean scores on a wide range of demographic and pretreatment characteristics are remarkably similar between the groups. Despite these baseline similarities, a curious pattern of divergence in outcomes emerges during the two-year study period. The odds of a technical violation are 36 percent greater among the GPS group, while the odds of a nontechnical violation are 20 percent greater. Conversely, the GPS group is less likely to be rearrested

overall (the chance of being rearrested is 26 percent lower) and for violent crimes (32 percent lower).

At first glance, these findings appear contradictory. However, an interpretation of the findings through the lens of a suppression program framework offers lucidity to the paradox. Suppression programs often use a combination of policing, prosecution, and incarceration to remove individual gang members from the community (Howell 2000). The goal of these programs is to influence the behavior of gang members by dramatically increasing the certainty, severity, and swiftness of criminal justice sanctions (Braga and Kennedy 2002). The use of GPS technology to monitor HRGOs falls within this context. In fact, one of the most common gang suppression programs involves the operation of special gang probation and parole caseloads with high levels of surveillance and more stringent revocation rules for gang members (Klein 2004). The program described in this study offers many of the same features but overlays GPS monitoring as an added level of surveillance.

With this in mind, the data suggests that CDCR utilizes GPS as a suppression program where the technology is used to monitor offenders with the goal of placing them back into custody for any injudiciousness. Specifically, CDCR utilizes parole violations (in lieu of an arrest and the associated court proceedings) as a means of returning GPS-monitored gang members back into custody.

3. Assess the Cost of the Program.

This study also provides details on the cost of the GPS monitoring program in comparison with the cost of traditional supervision. The analysis found that the cost of the GPS program is $21.20 per day per parolee, while the cost of traditional supervision is $7.20 per day per parolee—a difference of about $14. However, the results favored the GPS group in terms of the goal of the program—removing dangerous gang members from the community. In other words, the GPS monitoring program is more expensive but more effective. Specifically, when compared with traditional parole supervision, GPS monitoring costs $1.49 per day per offender more than traditional parole to obtain a 1 percent ***decrease*** in arrests. Conversely, due to the positive effect of GPS monitoring on technical and nontechnical violations, the GPS program costs $10.77 per day per offender to obtain a 1 percent ***increase*** in technical violations and $12.73 per day per offender to obtain a 1 percent increase in nontechnical violations.

POLICY IMPLICATIONS

Given the extreme nature of the gang problem, the response of criminal justice agencies to gang activity in California and other jurisdictions throughout the United States is a vital public safety concern. As indicated earlier, these responses can generally be grouped into three broad categories: prevention, intervention, and suppression. Suppression programs are generally considered the least effective gang program type (Decker 2002), but relatively few gang programs, regardless of strategy type, have been found to reduce the criminal behavior of gang members (Klein and Maxson 2006, Howell 1998, Spergel 1995), and little serious evaluation research has concentrated specifically on gang suppression strategies (Klein 1995). This research helps address fill this gap. Moreover it provides evidence that suppression programs designed to keep high-risk offenders off the street may offer benefits by decreasing community violence and increasing public safety. However, the cost analysis suggests that the GPS monitoring program is more expensive. Specifically it costs roughly $4 per offender per day more than traditional supervision. Is the increase in public safety worth the cost? While policymakers will ultimately be faced with the harsh decision of how much they are willing to pay for a safer community, there are a number of policy recommendations borne from the observations and findings of this study that could improve the effectiveness and/or reduce the costs of the program to make it more cost

effective and thus more attractive to policymakers. These recommendations are summarized below.

Not All Gang Offenders Are Created Equal

Unlike the GPS program for sex offenders in California, the GPS program for *gang offenders* does not utilize a standardized risk instrument to identify potential subjects for inclusion. Given that the goal of the program is to place dangerously *violent gang offenders* back into custody, it can be assumed that the most appropriate offender is an identified gang member with a high propensity toward violence. As a result, we recommend the adoption of a more formalized decision process that ensures that the targeted population is being served by the program. Specifically, we ***recommend incorporating a risk instrument designed to predict violent offending into the existing decision making process.*** For this purpose, some of the most common instruments include the Historical, Clinical, Risk Management-20 (HCR-20), the Violence Risk Appraisal Guide (VRAG), and the Structured Assessment of Violence Risk in Youth (SAVRY). Another possibility would be to employ the California Static Risk Assessment (CSRA) tool, an actuarial instrument specifically developed for and already in use in California.

Going Beyond Crime Mapping

While CDCR currently has the capacity to use their GPS monitoring program to run crime correlations, the use of GPS monitoring holds the potential for an unprecedented insight into gang-related activity. By its very nature, GPS technology allows for an exceptional gain in the geographic intelligence of gang member-activity by specifically tracking the mobility and engagements of a parolee. We recommend ***moving beyond traditional crime scene correlations to conduct social network analysis in order to identify the contacts, ties, and attachments that one gang has to another.***

Conduct a Cost Analysis on Outsourcing the Monitoring Center Function

Creating a monitoring center function is critical to the smooth operations of GPS programs, since the GPS supervision of paroles can generate an overwhelming amount of information. However, it should be noted that there are numerous ways to configure a monitoring center, some of which may be more or less costly to CDCR. Considering the volume of offenders on GPS monitoring in California and the cost associated with outsourcing the operation of the monitoring center***, we recommend that CDCR conduct a study to determine the marginal cost of internalizing the monitoring center.***

Push Criminal Prosecution

While back-end sentencing is not without some merit (e.g., swiftly removing potentially violent criminals from the community), the practice used in California permits some dangerous offenders to dodge the more severe penalties that would have been imposed had the cases been prosecuted in the criminal court system as opposed to being handled by the parole board. **We recommend that whenever possible parolees who commit new crimes, particularly crimes of a serious nature, be prosecuted to the fullest extent of the law in criminal courts.**

Continue to Emphasize the Use of GPS Monitoring as a Tool

The final recommendation has been offered elsewhere (Gies et al. 2012), but it bears repeating here. Public officials should ***bear in mind that GPS monitoring is merely a tool useful in the larger context of parole practice. It is not a panacea for all things criminal.*** This recommendation is borne from the inflated expectations of GPS monitoring attributable to the misconceptions about what GPS monitoring can actually accomplish (Payne and DeMichele 2011). While California recognizes this concept and integrates this principle into its training, its importance cannot be overstated.

Thoughtfully Grow the Program

Recent evidence suggests that GPS monitoring is a useful supervision tool. However, little research has investigated the use of GPS technology as a tool to deter criminal behavior by removing serious and violent offenders from the streets. While not conclusive, this study provides promising evidence that GPS technology offers increased public safety by potentially removing dangerous criminals from the streets before they commit more violent crimes. *It is recommended that CDCR carefully weigh the benefits and detriments of the program, but consider expanding the GPS monitoring of HRGO to additional units*. The main benefit appears to be the potential for increased public safety. The key detriment rests on the increased costs: not only the costs of operating the GPS program, but also the costs associated with returning these offenders to custody.

1. Background

A. Introduction

Purpose

The street gang culture in Los Angeles is legendary (Howell et al. 2011) and has been famously depicted in numerous Hollywood films such as *Boyz n the Hood*, *Training Day,* and *Colors*, to name a few. In fact, Los Angeles has been dubbed by some as the "the gang capital of the world" (The Advancement Project 2007, p. 1). However, gangs in California are not limited to the City of Los Angeles. There are roughly 250,000 members* statewide in 336 different gangs (NGTA 2011). Although these street gangs are typically not highly organized (Howell 2012), the individual members are involved in a host of violent criminal activities, including assault, drug trafficking, extortion, firearms offenses, home invasion robberies, homicide, intimidation, shootings, and weapons trafficking. In fact, a recent analysis conducted by the National Gang Intelligence Center indicates gang members are responsible for an average of 48 percent of violent crime in most jurisdictions, and for a much greater percentage of violent crime in states like California with a large concentration of gang members, where it is estimated that gangs are responsible for at least 90 percent of crime (NGTA 2011).

Moreover, despite the overall dramatic declines in violent crime nationally, Howell and colleagues (2011) found overwhelming evidence that gang violence rates have continued in California and throughout the country at exceptional levels over the past decade. In fact, they suggest gang violence is rather commonplace in very large cities and seems largely unaffected by, if not independent from, other crime trends (Howell et al. 2011).

Consequently, street gang activity and the criminal justice response in California and other states and localities throughout the United States remain important and significant inquiries. One response in California has been to use Global Positioning System (GPS) monitoring of high-risk gang offenders (HRGOs)† who are placed on parole. It is hypothesized that the GPS monitoring technology deters offenders from engaging in criminal behavior and encourages parolees to be more compliant because it increases probability of detection by law enforcement. The purpose of this evaluation is to determine the effectiveness of this strategy.

Background

The impetus for this project began in July 2005 when the California Department of Corrections and Rehabilitation (CDCR) began a pilot program in San Diego testing the use of GPS technology to monitor high-risk sex offenders on parole. The success of the pilot project prompted CDCR to expand the program across the state. Implementation of the full statewide program was completed in December 2008 after phasing in 4,800 GPS monitoring units (Gies et al. 2012). This figure nearly triples the 1,800 GPS units used by Florida, the second-leading state to use the devices. As of August 2011, there were 9,912 sex offenders on parole in California (9 percent of all parolees under the jurisdiction of the CDCR). Roughly 7,022 of these sex offenders were living in the community and 6,968 (99.2 percent) were monitored by GPS technology.

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* The NGIC report estimates there are six gang members per 1,000 people in the state. The population of California is roughly 38 million. Thus, we estimated the gang population in the following manner (38,000,000/1,000)*6=228,000).

† In this report, the term gang offender refers to an individual identified as either a prison or criminal street gang member. See page 1-13 for more details.

The generally positive experiences among parole agents (PAs) with the sex offender monitoring program spiked interest in applying the same technology to monitor other types of offenders. After thoughtful consideration and contemplation, CDCR took steps to use this technology to address the severe gang problem that plagued the state. In March 2006, CDCR's Division of Adult Parole Operations entered into a partnership with the city of San Bernardino to implement a pilot project similar to the San Diego program to track the movements of known gang members. The San Bernardino pilot program established a 20-unit specialized gang parole caseload that uses GPS technology as a supervision tool for active gang member parolees who have a history of violence and weapons possession and who are identified as a public safety risk to the city.

In May 2007, Gov. Arnold Schwarzenegger proposed an antigang initiative known as the California Gang Reduction, Intervention, and Prevention (CalGRIP) program to provide more than $48 million in state and federal funding for local antigang efforts, including job training, education, and intervention programs. CalGRIP also expanded the pilot program in San Bernardino to an 80-unit program by adding 20 units each in the City of Los Angeles and the following California counties: Fresno, Los Angeles, Riverside, Sacramento, and San Bernardino.* This study focuses on HRGOs who were released from prison and placed on parole supervision with GPS monitoring in these six original jurisdictions from March 2006 through October 2009.

How GPS Works

GPS is a space-based global navigation satellite system that provides location and time information in all weather, anywhere on or near the earth. The initial GPS project was developed in 1973 as a military application to overcome limitations of previous navigation systems, integrating ideas from several predecessors, including numerous classified engineering design studies from the 1960s. However, in the 1980s, the government made the system available for civilian use, and GPS became fully operational in 1994. The system is freely accessible by anyone with a GPS receiver (although some of the more sophisticated technologies are reserved for military users).

The GPS system consists of three major segments. These are 1) the space segment (SS), 2) the control segment (CS), and 3) the user segment (US). The U.S. Air Force developed, maintains, and operates the SS and CS. The SS segment comprises 24 to 32 satellites orbiting the earth at an altitude of approximately 20,000 kilometers. The CS comprises a master control station, an alternate master control station, and six monitoring stations around the globe. Finally, the US comprises hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service and tens of millions of civil, commercial, and scientific users of the Standard Positioning Service.

These three segments work in concert to produce accurate time and position information. The GPS satellites (SS) circle the earth twice a day in a precise orbit and continuously transmit signal information (i.e., the time the message was transmitted, precise orbital information, and general system health). Notably, all GPS satellites synchronize operations so these repeating signals are transmitted at the same instant. The synchronized signals, moving at the speed of light, arrive at the GPS receiver (US) at slightly different times because some satellites are farther away than others. The distance to the GPS satellites can be determined by estimating the amount of time it takes for their signals to reach the receiver. When

* The GPS supervision of HRGOs subsequently expanded to a number of other jurisdictions and then contracted due to budget considerations during the course of this study. This research focuses on the original six jurisdictions.

the receiver estimates the distance to at least four GPS satellites, it can calculate its position in three dimensions (latitude, longitude, and altitude). However, a receiver can determine a two-dimensional position (latitude and longitude) from only three satellites. Regardless of method, this position is then displayed on a map for the user. Many GPS receivers also show derived information such as direction and speed, which are calculated from position changes. Finally, the monitoring stations (CS) are used to precisely track each satellite's orbit and synchronize the signals. The flight paths of the satellites are tracked by dedicated U.S. Air Force monitoring stations in Hawaii; Kwajalein in the West Pacific; Diego Garcia in the Indian Ocean; Ascension Island in the South Atlantic; Cape Canaveral, Fla.; and Colorado Springs, Colo. The tracking information is sent to the Air Force Space Command in Colorado Springs, which contacts each satellite regularly with a navigational update. These updates synchronize the atomic clocks on board the satellites to within a few nanoseconds of one another and adjust the orbital information of each satellite.

ACCURACY. The accuracy of a position determined with GPS depends on the type of GPS receiver. Most handheld GPS units are accurate to within 15 meters on average. Other types of receivers use enhancement methods such as Differential GPS (DGPS) to obtain much higher accuracy. DGPS requires a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the satellite systems and the known fixed positions. Observations made by the stationary receiver are used to correct positions recorded by the roving units, producing an accuracy greater than 1 meter. Other methods such as Real Time Kinematic and Post Processing can enhance accuracy even further but at a significantly increased cost. Consequently, these enhancement methods are typically used only in more advanced applications such as land surveying. When used properly under ideal conditions, the accuracy of each method is approximated as follows:

- Autonomous: <10m
- Differential GPS: 0.3–2.0m
- Real Time Kinematic: 0.05–0.5m
- Post Processing: 0.02–0.25m

LIMITATIONS. GPS receivers require an unobstructed view of the sky and often do not perform well because of interference from buildings, terrain, electronics, or sometimes even dense foliage. These obstructions can cause position errors or possibly no position reading at all. Consequently, GPS units typically do not work well indoors, underwater, or underground. Other factors that can degrade the GPS signal and thus affect accuracy include the following:

- ***Atmospheric disturbances.*** This error occurs when the satellite signal slows as it passes through the atmosphere. The GPS system uses a built-in model that calculates an average amount of delay to partially correct for this type of error.

- ***Signal multipath.*** This error occurs when the GPS signal is reflected off objects such as tall buildings or large rock surfaces before it reaches the receiver. This increases the travel time of the signal, thereby causing errors.

- ***Receiver clock errors.*** This error occurs when the receiver's built-in clock is not as accurate as the atomic clocks onboard the GPS satellites, resulting in very slight timing errors.

- *Orbital errors.* This error is due to inaccuracies of the satellite's reported location.

- *Satellite geometry/shading.* This error refers to the relative position of the satellites at any given time. Ideal satellite geometry exists when the satellites are located at wide angles relative to each other. Poor geometry results when the satellites are located in a line or tight grouping.

B. Literature Review

Research on gangs has grown tremendously since the 1980s, providing a wealth of information on who joins gangs and why, what types of criminal activities gangs encourage, recidivism rates for ex-offenders who are gang affiliated, and what works in prevention and intervention/reentry. Still, continuing rates of gang activity and violence make it clear that we are still seeking effective ways to interrupt gang activity and manage ex-offenders as they reenter their home communities to reduce the adverse impacts.

Gang Prevalence, Membership and Activity

According to the National Gang Center, the number of gangs has grown from a low in 2003 of around 20,000 to an estimated 30,000 in 2011; this represents a 12 percent increase from 2006 and is the highest annual estimate since 1997. As of 2011, there were approximately 782,500 gang members. These gangs and their activities constitute a pervasive problem throughout the country, as demonstrated by a recent trend analysis of U.S. gang problems from 2002 to 2009 (Howell et al. 2011). Although the nation has experienced an overall decline in rates of violent crime, this trend has not affected gang violence. Rather, rates of gang violence have continued relatively unchanged during this period for most cities with populations of 50,000 or more. In some of the largest cities, the percentage of homicides that are gang related is very high—in 2009, one third of homicides in Chicago and one half of homicides in Los Angles were gang related.

The peak age range for gang membership is roughly 14 to 15 (Huff 1998). This finding is remarkably consistent across self-report studies, regardless of the risk level of the sample, the restrictiveness of the gang definition, and the study location (Klein and Maxson 2006). However, the peak age range may be older in cities where gangs have existed longer (Curry and Decker 1998). For instance, in 2011, law enforcement reported that more than three out of every five gang members were adults (National Gang Center). The proportion of adult member to juveniles was larger for larger cities and suburban counties than for smaller cities and rural counties. The typical range for gang members is ages 12 to 24.

The gender and racial/ethnic composition of gangs has remained relatively stable over the past decade. Although female gang membership may be increasing (Klein 1995), virtually all studies agree that males join gangs at higher rates. In fact, the prevalence rates for males are 1½ to 2 times as high as those for females in most studies—a pattern that transcends different study approaches (Klein and Maxson 2006). Data from the National Youth Gang Survey indicate females continue to make up less than 10 percent of gang membership. Data also indicate that the ethnic composition of gang members remained relatively stable during the 1996–2011 survey period, although there is also a wide ethnic/race differential in gang membership. According to the National Youth Gang Survey, in 2011 the ethnicity of gang members was roughly 46 percent Hispanic, 35 percent African American, 11 percent white, and 7 percent other race/ethnicity. This pattern is consistent regardless of the definition of *gang* and the nature of the sample approaches (Klein and Maxson 2006). The disproportionate representation of minority groups in gangs is not a result of a predisposition toward gang membership; rather, minorities tend to be overrepresented in areas overwhelmed with gang activity (Bursik and Grasmick 1993).

While most cities and jurisdictions generally do not record criminal offenses other than homicides and graffiti as gang related, research has provided insight into the nature of gangs' criminal activity. The research demonstrates that although gang members commit a fair share of violent crime, gang members do not necessarily specialize in violence. Instead, they tend to be "generalist in nature, spanning the range of the cafeteria of delinquency choices" (Klein and Maxson 2006, see also Thornberry et al. 2003). Gang members do, however, commit a disproportionate number of offenses compared with non-gang members (Klein and Maxson 2006, Thornberry et al. 2003, Miller 2001). For instance, in a recent comparison of patterns of offending among gang and non-gang youth in Dutch and U.S. youth samples, Esbensen and Weerman (2005) found gang members are four to six times as likely as non-gang youth to engage in minor and serious delinquency. Data from the Rochester Youth Development Study indicate that gang members are seven times as likely as non-gang youth to commit delinquent offenses (Bjerregaard and Smith 1993). This relationship is robust across a wide variety of definitions of *gang* and across different measurements of offending (Klein and Maxson 2006); it also holds up when gang members are compared with other highly delinquent non-gang youth (Thornberry 1998, Huizinga 1997).

Recidivism of Gang Members

Many of these gang offenders go to prison, but what happens once they are released? During 2010, state and federal prisons released more than 700,000 prisoners (Reentry Facts). While no national estimates indicate what percentage of ex-offenders are former and current gang members, the reentry of these former and current gang members helps drive gang activity and violence in their home communities. More than one third of law enforcement agencies identified the return of gang members from secure confinement as a factor in local crime activity. The percentage of agencies identifying this return from secure confinement as a factor rose from 42 percent in 2006 to almost 53 percent in 2011 (National Gang Center). As Olson, Dooley, and Kane (2004) note, the practical impact of these ex-offenders' reentry can be substantial: the return of gang members released in Illinois during 2000 translated to nearly 11,000 adult gang-involved ex-offenders reentering home communities in that one year.

A growing number of quantitative and qualitative studies are assessing the recidivism rates of ex-offenders who are current or former gang members. Most studies have found ex-offenders are associated with a higher risk of recidivism than non-gang ex-offenders, whether the ex-offenders are juveniles, young adults, or adults.

The relationship between gang affiliation and juvenile offender recidivism has been assessed in multiple studies. For instance, using event history analysis for a sample of 2,435 state incarcerated delinquents, Caudill (2010) found gang affiliates have a significantly higher risk of recidivating within 6 months of release compared with non-gang ex-offenders. However, the risk ratios of the two groups converge shortly after that. In a study of 1,804 serious and violent delinquents released from a large southern correctional facility, Trulson and colleagues (2012) found gang murderers had a higher risk of rearrest and any felony re-arrest than non-gang murderers, after controlling for youth characteristics, delinquent background, and social history measures.

A similar relationship between gang affiliation and increased recidivism is found for young adult and adult samples. Huebner, Varano, and Bynum (2007) assessed recidivism among 322 young men aged 17 to 24. Proportional hazard models indicated gang membership is one of the critical factors in predicting the timing of reconviction (other factors included race, drug dependence, and institutional behavior). Fifty-six

percent of gang members and drug-dependent offenders recidivated, with an average time of 29 months to reconviction, compared with the 28 percent of non-gang and non-drug-involved offenders who recidivated, with an average time of 37 months to reconviction. Analysis revealed that, compared with drug-dependent individuals, gang members recidivated at higher rates (45 percent compared with 29 percent) and more quickly (40.34 months compared with 32.59 months). In a study of California parolees, McShane, Williams III, and Dolny (2003) found gang members have higher recidivism rates across all commitment offense categories compared with the general parole population, even after controlling for age. It was also found that gang members were more likely to engage in certain types of crimes that result in greater recidivism. The researchers concluded that although gang membership was not one of the strongest predictors of recidivism, it had an independent, negative effect on recidivism.

A study by Olson, Dooley, and Kane (2004) also looked at the relationship between recidivism and gang membership among 2,534 adult inmates released from prison in Illinois in November 2000. Similar to the studies cited above, this study found that, compared with non-gang ex-offenders, gang members were more likely to get rearrested, be rearrested more quickly after release, and be arrested for violent and drug offenses. This relationship held even after controlling for variables such as inmate and neighborhood characteristics. Given the large sample, Olson, Dooley, and Kane were able to examine rearrest rates for four age groups (17–24, 25–31, 32–39, and 39+). Contradictory to the findings by Huebner, Varano, and Bynum (2007), the relationship between recidivism and gang membership was weak for the young adult group and the 32–39 aged group: gang and non-gang members in these age groups were rearrested at similar rates (however, Olson, Dooley, and Kane did not treat drug-dependent offenders as a separate group). The relationship was strongest for the 25–31 and 39+ groups (both almost twice as likely to be rearrested compared with non-gang members). They conclude that the evidence from their study suggests the age–crime curve better characterizes non-gang members, where older age was associated with lower recidivism.

Although such quantitative studies have established the link between gang affiliation and increased recidivism, a number of qualitative studies have explored why ex-offenders recidivate. Olson, Dooley, and Kane (2004) found gang members in their sample were more likely to be characterized by risk factors that predict recidivism. Thus, in the Illinois sample, gang members being released were more likely to be younger, male, minority, single/never married, and have lower levels of education. The community to which offenders return also affects recidivism. Huebner, Varano, and Bynum (2007) found men who returned to disadvantaged communities were reconvicted more quickly. Olson, Dooley, and Kane also found a higher proportion of gang members in their sample returned to neighborhoods in Cook County/Chicago compared with a higher proportion of non-gang members who returned to other urban areas of the state.

Social networks and social identity play a role in continued criminal activity. Scott (2004) found through a series of ethnographic interviews with 12 ex-inmates that the draw for individuals to street-level drug work stemmed less from the money involved than from the social network and activities involved in that work. According to interviews with 39 Chicago-area ex-convicts, many ex-offenders essentially "cocoon" themselves in close family and friend networks (Scott, Dewey, and Leverentz 2005). While these close ties afford ex-offenders material and non-material benefits in the short term, they limit the extent to which ex-offenders develop "weak ties" with the extended community. It is these "weak ties" that enhance social capital (e.g., by connecting them to individuals who can support attainment of personal goals, such as employment). Moreover, this link to former gang networks is reinforced in returning ex-offenders by

community mistrust and the abrasive tactics used by police toward ex-offenders (Scott 2004). Decker and Pyrooz's (2011) study of 177 ex-offenders indicate the difficulty of disrupting ties with a gang: Even when former gang members have shifted on measures of embeddedness—the degree to which gang members are immersed in activities of and feel commitment to the gang—and no longer consider themselves gang members, the social networks around them—as represented by rival gang members and police—may still consider them gang members. Seventy-four percent of former gang members reported that police continued to treat them as gang members when they had left the gang (including being stopped and questioned about gang activity, their names being retained in gang databases, and being arrested; Decker and Pyrooz 2011).

Scott, Dewey, and Leverentz (2005) note the tendency of much reintegration research to embrace binaries (e.g., either successes or failures at reintegration; either working or not working), which rarely captures the reality of the lives of ex-offenders. Fleisher and Decker (2001) emphasize the gradual nature of disengagement from gang membership, as self-identification to a gang may persist for years and gang identity provides important social ties. Decker and Pyrooz (2011) also found evidence for a long-term disengagement process: although concerns of former gang members being harassed by rival gang members and police decreased over time, concerns remained high over time. In short, "being recognized as a former member is complex, gradual, and perceived differentially by different groups" (15).

Programs

Gang programs can generally be grouped into three broad categories: prevention, intervention, and suppression. In general, prevention strategies keep youth from joining gangs, while intervention strategies seek to reduce the criminal activities of gangs by pulling youth away from gangs. These strategies typically include community organization, early childhood programs, school-based interventions, and afterschool programs. Interestingly, relatively few intervention programs target reentering populations of ex-offenders with gang affiliations (for instance, in the What Works in Reentry Clearinghouse, there is no topic area devoted to gang offenders, and a search on "gang" identifies only two programs), although materials have been developed to help jurisdictions create gang desistance plans (e.g., see Young and Gonzalez 2013).

Suppression programs use the full force of the law—generally through a combination of policing, prosecution, and incarceration—to deter criminal activities of entire gangs, dissolve gangs, and remove individual gang members from gangs (Howell 2000). Typical suppression programs include street sweeps, school-based law enforcement programs that use surveillance and buy–bust operations, civil procedures that use gang membership to define arrest for conspiracy, prosecution programs, and special gang probation and parole caseloads with high levels of surveillance and more stringent revocation rules for gang members (Klein 2004).

The use of GPS technology to monitor HRGOs falls within the suppression category, given that the goal is to influence behavior of gang members by dramatically increasing the certainty, severity, and swiftness of criminal justice sanctions (Braga and Kennedy 2002). Although suppression is universally considered to be the most fashionable response to gangs, it is also perceived to be the least effective (Decker 2002). However, relatively few gang programs, regardless of strategy type, have been found to reduce the criminal behavior of gang members (Klein and Maxson 2006, Howell 1998, Spergel 1995), and little serious evaluation research has concentrated specifically on gang suppression strategies (Klein 1995). Moreover, one of the most successful gang programs noted in the literature is primarily a suppression strategy. The Tri-Agency Resource Gang Enforcement Team (TARGET) is a gang crime–intervention

program in Orange County, Calif., intended to provide a strong criminal justice response to offenses committed by gang members. Similar to the GPS program, the goal of TARGET is to reduce gang crime by selectively incarcerating the most violent gang offenders. It accomplishes this goal by identifying repeat gang offenders based on their criminal record and monitoring them closely for new offenses. When a gang member is arrested, the offender is prosecuted by the district attorney assigned to the TARGET unit to obtain the lengthiest period of incarceration possible to deter future criminal offending. An evaluation of the program found the placement of repeat gang offenders in custody appears to have had an effect on reducing gang crime (Kent, Donaldson, Wyrick, and Smith 2000). During the first year of the program (1992), gang crime decreased by 11 percent. The cumulative reduction in gang crime was 64 percent through 1993, 59 percent through 1994, and 47 percent through 1997.

Despite these encouraging findings, suppression programs are still perceived to be less effective than some other strategies designed to reduce criminal behavior of gang members. Given this discrepancy and many other unanswered questions regarding the effectiveness of gang programs, there is still a critical need for high-quality evaluation research on gang programs (Decker 2002). This research helps address this need.

Electronic Monitoring

Electronic monitoring (EM) devices have increasingly been used in prison diversion and release programs over the past decades. Such devices include polygraphs, random calling and voice verification, remote alcohol monitoring, sleep pattern analysis, motion detection analysis, check-in kiosks, and GPS systems (IACP 2008). EM—particularly GPS devices—has become a popular tool for monitoring paroled offenders.

Background. The first electronic monitoring devices were developed in the 1960s by a group of researchers at Harvard University, with the main purpose of providing feedback to offenders fitted with the units. The feedback was meant to provide social support and facilitate rehabilitation (Burrell and Gable 2008). However, this device failed to gain acceptance, and it was not until the 1980s that EM reemerged. The climate had changed considerably, with the emergence of a more punitive model of offender treatment. Technology made possible increased surveillance and enforcement in the community setting.

The decision of New Mexico State District Judge Jack Love in 1983 to sentence three offenders to home detention with EM has taken on an almost mythic status. To fulfill his vision, he first had to convince someone to manufacture the transmitter devices. Since those early days, the pool of manufacturers and service providers has been in flux (Burrell and Gable 2008), but part of the dramatic growth in the use of EM is due to the aggressive marketing of these private companies (Black and Smith 2003; Lilly, 2006). From those first three offenders in 1983, it has been estimated that approximately 100,000 offenders were on EM in 2006 (Conway 2006, as cited in Burrell and Gable 2008). The usability of these units was enhanced considerably when the military discontinued the policy in 2000 of "selective availability," which had made civilian receivers significantly less accurate than military receivers (Florida Senate Committee on Criminal Justice 2004).

Radio Frequency and GPS Monitoring. Two types of EM are used most frequently for monitoring offenders. The first, radio frequency monitoring (RF), is used to determine whether an offender on house arrest is at home. The offender wears a tamper-resistant small transmitter that communicates with a small receiving unit connected to the phone line. If the signal is lost, the receiving unit communicates with

the monitoring station, which in turn can notify the probation officer. These systems can accommodate work or religious schedules, so offenders can be off site at scheduled times. Officers can also use a "drive by" monitoring device to check if the offender is at home or in treatment as scheduled. A radio frequency (RF) unit is the least expensive form of monitoring and costs about $2.75 per day (Florida Senate Committee on Criminal Justice 2004).

The second system, GPS monitoring, uses a network of satellites to calculate the physical position of the offender. The offender wears a tamper-resistant bracelet that receives transmissions from the satellites and calculates his or her location. With a passive GPS system, this information is stored and transmitted at appointed times to the monitoring station. With the active GPS system, information on the individual's location is transmitted to the monitoring station in near "real time." This allows the station to alert the probation officer immediately when a violation occurs. Both active and passive GPS systems allow certain zones to be excluded (such as crime hot spots or rival gang territories) or included (such as a work zone) and provide information on where and when an individual has been throughout the course of the day. The passive GPS system costs about $4 per day, and the active system costs about $9 per day (Florida Senate Committee on Criminal Justice 2004).

GPS has garnered an increasing amount of attention. But though there are multiple benefits to its use, officials in the justice and corrections systems, as well as the general public, need to be aware of potential shortcomings. The International Association of Chiefs of Police (IACP) has identified four main benefits of GPS:

1. ***Flexibility.*** GPS offers an alternative to incarceration, which is expensive. It also can be tailored for individual offenders so specific geographic areas can be selected for inclusion (the offender can visit that area) or exclusion (the offender must avoid that area to avoid a violation alert being sent).

2. ***Reintegration.*** GPS may promote compliance with the conditions of supervision and treatment, since locations can be tracked.

3. ***Control.*** The criminal justice system retains the ability to track and respond to the movement patterns of offenders, and the equipment provides a tangible and continuing reminder to the offender that monitoring is ongoing.

4. ***Investigation.*** It is possible to use location information to confirm an individual is or is not a suspect for a particular crime.

While these benefits make GPS attractive, there still are concerns about GPS. IACP has identified the following four issues:

1. ***Limited empirical support.*** Findings from research studies on EM's impact on recidivism are mixed (see below).

2. ***Increased officer workload.*** Though early advocates of EM believed this tool could increase the manageable caseload under supervision, experience with the technology has suggested the opposite. This workload increase stems from multiple factors, such as the need for officers to

monitor GPS equipment, to respond to alerts (many of which can be "false" alerts [Elzinga and Nijboer 2006]), to teach offenders how the equipment works, and to ensure the equipment is maintained and replaced when it fails. Sachwald (2007) noted that in Maryland's experience of implementing GPS, hardware failures occurred for about half of the offenders placed on GPS, and the equipment occasionally had to be replaced two or even three times before it worked. In light of such realities, the Florida Department of Corrections recommended the total caseload burden diminish with the introduction of EM, so supervising officers have a caseload of 25:1 with no EM, 22:1 for radio frequency monitoring, 17:1 for active GPS monitoring, and 8:1 for passive GPS monitoring (Florida Senate Committee on Criminal Justice 2004).

3. *False sense of security.* The public may not understand the limitations of this technology and assume it is a panacea. In truth, GPS is a tool—and one that can fail. For instance, in a pilot study, some intentional violations on the part of volunteers were not detected by the system (Elzinga and Nijboer 2006). There are also documented instances of "false" readings, such as when offenders were recorded in one place when officers knew them to have been elsewhere (Sachwald 2007). Also, although GPS units may be able to track where offenders are, they cannot provide information on what offenders are doing.

4. *Legal concerns.* Courts have not yet decided how to resolve challenges to the use of GPS. If equipment malfunctions and a crime is committed, will departments be held responsible? What happens if the department fails to respond to an alert? Lawsuits over such matters could cost departments millions of dollars in court costs and damages.

USES OF EM. EM can be used at different points in the judicial system—for example, for pretrial supervision as an alternative to jail, as an alternative to incarceration for selected offenders, or as part of a mandated supervision program after release from prison.

It also can be used for different purposes, including

- Public safety
- Safety of individual victims
- Accountability of offenders
- Behavior change and recidivism reduction
- Reduction of jail or prison populations
- Reducing costs

Notably, not all of the purposes are mutually compatible (Florida Senate Committee on Criminal Justice 2004). Thus, departments using EM should clarify their goals at the start of the program.

Some critics (e.g., Lilly 2006, Nellis 2006) have noted the absence of rehabilitation as an overall goal for the use of EM, contrary to the intent of its earliest developers. In response to this absence, Burrell and Gable (2008) have proposed the development of an incentive-based model of EM that could integrate a rehabilitation component through the use of positive reinforcement. They note this type of model fits into the framework of evidence-based practices and point to the success of drug courts in using positive reinforcement to shape offender behavior and facilitate rehabilitation.

EFFECTIVENESS OF EM. The research on the effectiveness in reducing recidivism is still somewhat mixed, although the base confirming GPS effectiveness is growing. This result stems in large part from the limitations of many extant studies. For instance, the 1997 report to the U.S. Congress (Sherman et al. 1997) categorized home detention with EM as an approach that "doesn't work." This conclusion, however, was based on the only two studies deemed to have adequately rigorous designs (Burrell and Gable 2008). A 2005 meta-analysis of 119 studies on the use of EM with moderate- to high-risk offenders, conducted by Marc Renzema and Evan Mayo–Wilson, faced a similar problem with study limitations. They concluded "all studies [of EM] in moderate- to high-risk populations have serious limitations and matched studies of EM in moderate- to high-risk populations are of very low quality." Only 3 of the 119 studies considered by Renzema and Mayo–Wilson incorporated a control or comparison group in their research design, and all three produced inconclusive results on the value of EM. (For example, Finn and Muirhead–Steves' 2002 study of the EM program in Georgia found sex offenders on EM were less likely to reoffend than their counterparts in the comparison group, but Renzema and Mayo–Wilson also found "evidence that EM may not have produced the observed differences.")

However, some recent studies, with rigorous research designs, suggest the optimism about the potential of EM may not be groundless. For instance, a 2006 study conducted by researchers at the University of Florida makes a slightly stronger case for EM. Padgett, Bales, and Blomberg analyzed data from 75,661 serious offenders in Florida who had been placed on home confinement between 1998 and 2002 and found that "Both radio frequency and global positioning system monitoring significantly reduce the likelihood of technical violations, reoffending, and absconding for this population of offenders." The positive effect was particularly noteworthy since the population placed on EM was a significantly higher risk population. However, Padgett, Bales, and Blomberg also found EM had a lesser impact on sex offenders than on other offender groups. Although violent offenders on GPS monitoring were 91.5 percent less likely to commit a new offense than violent offenders who were not electronically monitored, sex offenders were only 44.8 percent less likely to commit a new offense. This small treatment effect is probably the result of *most* sex offenders' relatively low tendency to be rearrested. They also noted that, given the efficacy of both RF and GPS, the price differential for their use is substantial—an important consideration for policymakers.

A 2010 study conducted by researchers at Florida State University also offers evidence for the effectiveness of EM. For their quantitative analysis, Bales and colleagues analyzed data on 5,034 medium- and high-risk offenders on EM and 266,991 offenders not placed on EM over a 6-year period; they used propensity score matching to minimize selection bias. The researchers found EM reduced offenders' risk of failure by 31 percent; within the EM group, GPS monitoring resulted in 6 percent fewer supervision failures, compared with RF. They noted that all categories of offenders, regardless of offense type, experienced fewer supervision violations as a result of EM; however, the effect was reduced for violent offenders. For their qualitative analysis, the researchers conducted interviews with 105 offenders, 36 supervising officers, and 20 administrators from throughout Florida. They found that offenders and their families suffered negative consequences, including poorer relationships with significant others and children and offenders' more frequent inability to obtain and retain employment. They also concluded that EM appeared to be a cost-effective method for dealing with offenders.

Two studies released in 2012 provide growing evidence for the effectiveness of using GPS for different populations. A 2012 study of 516 high-risk sex offenders in California assessed the outcomes of those receiving traditional parole supervision compared with those receiving GPS supervision (Gies et al. 2012).

The two main outcomes of interest were noncompliance (measured through violations of parole) and recidivism (measured through rearrest, reconviction, and return to prison). Gies and colleagues used a survival analysis of time-to-event recidivism data, using a Cox proportional hazards model. The study found the hazard ratio of a sex-related violation was nearly three times as great for subjects who received traditional parole supervision than for subjects who received the GPS supervision. In terms of recidivism, compared with subjects who received the GPS monitoring supervision, the hazard ratio for any arrest was more than twice as high among subjects who received traditional parole supervision.

A 2012 study by Erez and colleagues examined the use of GPS for enforcing court-mandated "no contact" orders in domestic violence cases. The study examined the outcomes for more than 3,600 defendants referred to the GPS program across three sites. Outcomes of interest included short-term outcomes (defendants' program violations and rearrests during the pretrial period) and long-term outcomes (rearrests during a 1-year follow-up period after the case). The results indicated GPS was associated with practically no contact attempts. Furthermore, defendants enrolled in GPS monitoring had fewer program violations compared with those placed in traditional electronic monitoring (EM) that used RF technology. Erez and colleagues also found defendants on GPS had similar conviction rates across the three sites to those who remained in jail during the pretrial period.

These findings provide promising evidence that EM can reduce recidivism. Still, none of the existing studies on EM has shown EM does more than *postpone* recidivism. Parolees appear to be compliant while subject to monitoring, but, in the words of Peckenpaugh and Petersilia (2006), "when the bracelets come off, other studies have found that monitored offenders perform no better than offenders [who] were never subject to monitoring." Gainey, Payne, and O'Toole (2000) have raised the related issue of whether time spent on EM affects recidivism. Their review of the limited research on the relationship between recidivism and time served and the relationship between time on EM and program completion led to mixed findings. Their own study found the more time offenders spent on EM, the lower the likelihood of recidivism. However, this result varied by type of offender. These findings are provocative but provide only a starting point for answering questions about the impact of EM on recidivism after the removal of EM. They also suggest the need for further research about the impact of EM when it is part of a comprehensive program and is not studied—as do Padgett, Bales, and Blomberg (2006) and Bales and colleagues (2010)—in isolation from other program components.

C. The California Department of Corrections and Rehabilitation's Global Positioning System Supervision Program

CDCR is charged with the responsibility of administering the program to monitor with GPS technology all offenders released from prison, living in the community, and placed on a specialized gang caseload. According to the original CDCR policy protocols, the sanctioned goals of this program are identical to those of the sex offender program. They include the following:

1. Use the technology to gather information that can enhance supervision.
2. Provide PAs and local law enforcement with the ability to monitor the location and movement of targeted parolees.
3. Aid in the investigation of parole violations and criminal investigations.
4. Strengthen partnerships with local law enforcement agencies.

Informally, however, the goal of the gang program is very different from that of the sex offender program.

Whereas GPS is used to legitimately manage sex offenders in the community, anecdotal evidence indicates GPS is used to monitor gang offenders with the intent of returning them to prison as soon as possible as a public safety measure. Another difference between the programs is a differentiation in supervision requirements by risk level. For example, in contrast to the sex offender program, where the tracks of low-risk offenders are reviewed less frequently, the tracks of all offenders placed on a specialized gang offender caseload are reviewed daily. In addition, specialized gang caseloads

- CANNOT exceed 20 cases.
- Can include ONLY active GPS cases.
- Can include ONLY GPS–monitored parolees.
- Can include ONLY gang offender parolees.

Eligibility for and Designation of High-Risk Gang Offender

All GPS cases are assigned to a specialized caseload that has specific distinct requirements differentiating it from a traditional parole caseload. To be eligible to be placed on the specialized gang offender caseload, a parolee must meet at least one of the mandatory criteria listed in CDCR Form 2203 (Rev. 0411 0), GPS Monitoring Gang Eligibility Assessment Criteria, prior to assignment. If the parolee meets any of these criteria, the Agent of Record (AOR) shall hold a case conference with the Unit Supervisor (US) to determine if placement on the caseload is appropriate*. The criteria include the following:

- The parolee has been verified as a currently active member/associate of a prison disruptive group pursuant to the California Code of Regulations, Title 15, Crime Prevention and Corrections, Division 3, Section 3378(c)(1).

- The parolee has been validated as a prison gang member/associate pursuant to the California Code of Regulations, Title 15, Crime Prevention and Corrections, Division 3, Section 3378(c)(1).

- The parolee has a special condition of parole to not associate with any prison gang, disruptive group, or street gang member pursuant to the California Code of Regulations, Title 15, Division 2, Section 2513(e).

- The parolee was convicted pursuant to Penal Code (PC) Sections 182.5 and 186.22 (i.e., active participation in any criminal street gang) and currently has a special condition of parole to not associate with any prison gang, disruptive group, or street gang member.

- The parolee is subject to gang registration requirements pursuant to PC Sections 186.30–186.32.

- The parolee is a party to an active court civil gang injunction.

* Unfortunately, this process is not standardized and no data exists on the details of the decision-making process. However, anecdotal evidence from formal and informal interviews suggests that each time an eligible subject is released from prison, the AOR and US discuss the merits and detriments of supervising the offender with GPS. Among the factors considered are the current size of the specialized gang caseload, the risk of violence in comparison to those already under GPS supervision, the offender's gang affiliation and status within the gang, the California Static Risk Assessment score, and collateral information received from other stakeholders (local law enforcement, special task forces, institutional/prison gang units, etc.).

- The parolee has been identified by CDCR staff or local law enforcement to be or have previously been involved in gang activity.

The PA and US may also use the following additional criteria to make a final determination:

- The AOR has reason to believe the parolee is not in compliance with current parole conditions, and enhanced parole supervision is required in the interest of public safety.

- The parolee has been identified by local law enforcement as being a suspect in a felony crime involving violence and/or weapons.

- The parolee has a controlling or non-controlling commitment offense(s) included in PC Section 667.5(c) (i.e., a violent felony).

- The parolee has a risk number value of 5 (i.e., high risk to commit violent offenses as determined by the California Static Risk Assessment).

The Program Components

The CDCR HRGO Monitoring Program is composed of two distinct elements: GPS monitoring and intensive supervision.* These components are described in detail below.

GPS MONITORING. The GPS monitoring component employs the tracking system of two different vendors: Satellite Tracking of People (STOP) LLC and Pro Tech. STOP is used in the southern portion of California (Regions 3 and 4),† and Pro Tech‡ is responsible for the northern areas (Regions 1 and 2). Although the terminology of the vendors differs, the capabilities of hardware and software are virtually identical. Each vendor employs an active monitoring system that combines cellular and GPS technology to automatically track the location of a parolee. The unit takes a data point every minute and transmits the location data every 10 minutes. The tracking device is a single-piece GPS unit that weighs about six ounces and is roughly the size of a computer mouse. The device is worn flush around the left ankle, secured by a tamper-resistant, fiber-optic technology strap and specialized security screws‡ to secure the strap to the device. The battery can operate longer than 48 hours on a single charge, and recharging takes roughly 1 hour from any standard 110-volt electrical outlet. The battery's lifespan is typically 1 to 2 years.

The software system of each vendor employs a combination of data integration, geomapping, and GPS technology to monitor parolees. Each vendor tracks information about parolee activities supplied by the GPS technology and transmits it to the supervising PA through the monitoring center. The monitoring center provides the PA with information in two basic forms: daily summary reports (DSRs) and immediate alert (IA) notification. For each parolee, a DSR is emailed to the PA each morning. The notification details

* It should be noted that unlike the GPS monitoring program for sex offenders, there is no mandatory treatment component.

† CDCR is organizationally and operationally divided into four distinct regions, with numerous districts within each region and numerous parole units within each district. Region 1 consists of the Central Valley, ranging from Bakersfield to the Oregon border, while Region 2 encompasses the coastal counties from Ventura to the Oregon border. Region 3 includes only Los Angeles County, and Region 4 consists of the southern counties of Imperial, Orange, Riverside, San Diego, and San Bernardino. (See attachment A for a map of CDCR regions.)

‡ Strap clips and bridge clips have replaced the screws to secure the strap since the time period of this study.

all activity recorded by the GPS unit, including charging activity, zone violations, strap tampers, and other violations. The PA must review all recorded activity and note any actions that stem from the notification. The notification also includes a direct link to a Web-based data system for a review of the "tracks" or movement patterns of any offender on any GPS caseload. The software plots the location and movement on an interactive Web mapping service application, allowing the PA to see the movements of a parolee and investigate any unusual or suspicious movement patterns. PAs are provided with laptops enabled with wireless Internet cards to allow access to software from the field.

An IA notification is automatically generated by the monitoring center and transmitted to the supervising PA* through a text message when the GPS unit records specific types of violations†. Upon receipt of an IA notification, the supervising PA must analyze and appropriately respond to the information contained within the notification. This investigation typically begins with the transmission of a signal that forces the unit to beep or vibrate, indicating the offender must either telephone or physically appear before the PA immediately. If these methods fail to resolve the problem and the event is regarded as a serious threat to public safety, the PA follows response protocols including but not limited to responding to inspect the device, attempting to locate the offender, etc. The PA may also contact local law enforcement for assistance. Each situation is different and while guidelines are given, agents and supervisors must use all available information to decide on the appropriate level of response.

The GPS monitoring technology includes numerous other features that aid the PA in monitoring the offender, including the following:

- ***Inclusion zone:*** A geographic location that an offender is required to occupy during certain times of day. The application of an inclusion zone enables the PA to be alerted to a parolee's movement out of the specific location. Inclusion zones may include but are not limited to the parolee's residence, employment, or treatment location.

- ***Exclusion zone:*** A geographic location that an offender is prohibited from entering at all or during certain times of day. Contrary to the inclusion zone, the application of an exclusion zone enables the PA to be alerted to a parolee's movement into a specific location. Exclusion zones may include but are not limited to the victim's residence, areas of known narcotic activity, prior arrest locations, or areas of restricted travel.

- ***Track mapping:*** Tools and procedures for analyzing an offender's movements on a map

- ***Status call button:*** A feature that initiates an audible tone and/or vibration from the receiver

* During the study period, the alert notification protocol operated as described. However, CDCR has subsequently altered this operational model to reduce the burden placed on PAs to respond to a multitude of minor alerts. Effective October 2012, alert notifications are now triaged through a Vendor Monitoring Center (VMC). The VMC follows preestablished protocols to triage GPS alert information. For less urgent alerts, the VMC will attempt to resolve issues directly with the parolee prior to PA involvement. In the event the VMC cannot resolve the alert with the parolee, it is escalated to the PA. For more urgent GPS alerts, the VMC will provide immediate notification to the PA in accordance with established IA notification protocols.

† The specific types of violations are known to the researchers. However, at the request of CDCR and to preserve the integrity of the parole program, this detail is omitted from the final report.

- ***Crime scene correlation:*** The intersection of crime incident data with GPS tracks to determine whether any offender was in the vicinity of a crime.

The specific requirements for the GPS supervision component calls for a PA assigned a specialized gang caseload to

- Review the DSR for each GPS-monitored parolee at regular intervals.
- Conduct a track review for each GPS-monitored parolee at regular intervals using specific methods.
- Immediately respond to all GPS alert notifications (exclusion, inclusion, tamper, gap, cell, battery).
- Resolve all GPS alert notifications and note actions taken to clear the event (exclusion, inclusion, tamper, gap, cell, battery).
- Assign a residence inclusion zone (or transient inclusion zone for homeless parolees), a travel restriction zone, and a victim exclusion zone (if applicable) (residence, travel, victim).

All PAs involved in the GPS program (whether or not directly supervising parolees) must be trained by the Division of Adult Parole Operations' EM unit in the use of GPS technology as a parole supervision monitoring tool. The training program covers a variety of information, including policies, procedures, and protocols when using GPS as a supervision tool. PAs must attend GPS training before supervising parolees using GPS.

INTENSIVE SUPERVISION. The intensive supervision component involves recurrent contact with HRGOs by PAs. The PA meets face-to-face with the parolee on the first working day after release and informs the parolee that GPS monitoring technology is being added as a special condition of parole and that participation in the program is mandatory (refusal will result in immediate revocation of parole and return to prison). Specifically, the traditional intensive supervision component requires a PA assigned a specialized gang caseload to

- Establish first contact with the parolee within a specific number* of days after release.
- Conduct the initial interview within a specific number* of days after release.
- Meet at the parolee's residence within a specific number* of days after release.
- Conduct a minimum number* of face-to-face contacts with the parolee each month.
- Conduct a minimum number* of collateral contacts per month.
- Meet with law enforcement to update parole information a minimum number of times* per year.

* The exact number is known to the researchers. However, at the request of CDCR and to preserve the integrity of the parole program, this figure is omitted from the final report.

- Conduct a minimum number* of random drug tests each month.

- Conduct a case conference review a minimum number* of times each year.

D. The Study Goals

Goals

The overall purpose of this study is to conduct a quasi-experimental evaluation of the CDCR GPS monitoring program of HRGOs. Specifically, the goals are to

- Assess the fidelity of the program.
- Assess the cost of the GPS program.
- Assess the effectiveness of the GPS program for gang offender.

Objectives

This project has set several highly specific objectives to measure the success of its goals. It should be noted that the objectives for the effectiveness goal do not predict a direction. This lack of direction is intentional due to questions (discussed above) regarding the gang program's intent. A deterrence-based program like the sex offender program would view a decline in criminal behavior as desirable because it results in fewer crimes. Conversely, a suppression-based program would likely see an initial increase in recidivism among the treatment subjects as a positive outcome because returning these offenders to custody may ultimately increase public safety. Nevertheless, the specific objectives of the project, organized by goal, are as follows:

1. Assess the Fidelity of the GPS Program.

- Determine the program adherence to all core components (i.e., program staffing qualifications, caseload restrictions, parolee orientation specifications, and parole supervision specifications).

- Determine the degree to which the prescribed level of program exposure was obtained.

- Determine the quality of program delivery (e.g., skill of the staff in using techniques or methods prescribed by the program and preparedness or attitude of staff toward the program).

- Determine the degree to which program components were reliably differentiated from one another.

2. Assess the Cost of the Program.

- Determine the cost of monitoring HRGOs with the GPS system.

- Determine the cost of monitoring HRGOs without the GPS system.

3. Assess the Effectiveness of the GPS Program for Gang Offenders

- Determine the effect of GPS monitoring on offenders' subsequent occurrence of noncompliance with parole conditions (i.e., technical violation and nontechnical violation).

- Determine the effect of GPS monitoring on offenders' subsequent occurrence of criminal behavior (i.e., rearrest for any offense and rearrest for a violent offense).

2. Methodology

A. Overview

This study integrates outcome and process evaluation components. The outcome component assesses the impact of the California Department of Corrections and Rehabilitation (CDCR) GPS supervision program by employing a nonequivalent-group quasi-experimental design with a multilevel survival model. We also use a propensity score matching procedure to account for differences between the treatment and comparison groups. The study population is drawn from high-risk gang offenders (HRGOs) (as determined by the GPS Monitoring Gang Eligibility Assessment Criteria Form) who have been released from prison and are residing in the State of California. The effectiveness of the program is assessed using an intent-to-treat (known as ITT) approach, with two main outcomes of interest: noncompliance and recidivism. Noncompliance is operationalized as a violation of parole. Recidivism, on the other hand, is operationalized as an arrest for a new crime. Each outcome is assessed with a survival analysis of discrete-time data, using a random intercept complementary log–log model. In addition, frailty modeling is used to account for the clustering of parolees within parole districts. The outcome component also includes a cost-effectiveness analysis of each outcome. The process component (see chapter 4) uses quantitative and qualitative methods to provide a rich context to the program treatment and structure and to assess program fidelity (i.e., whether the program was well-designed and implemented as intended).

B. Participants

California is notorious for having a substantial population of gang members. In fact, the 2010 Organized Crime in California Annual Report to the California Legislature suggests gangs operate in cities of all sizes throughout the state (Office of the Attorney General [OAG] 2010). In concordance with the OAG report, the 2011 National Gang Threat Assessment (NGTA) found California, Arizona, and Illinois are the states with the highest number of gang members in the country. With data collected by the National Drug Intelligence Center through the National Drug Threat Survey and National Gang Intelligence Center, the NGTA estimates there are more than six gang members per 1,000 people in the State of California (NGTA 2011).

In response to this problem, CDCR's Division of Adult Parole Operations in March 2006 entered into a partnership with the City of San Bernardino to implement a pilot project to track the movements of known gang members. In May 2007, Governor Schwarzenegger implemented the California Gang Reduction, Intervention and Prevention initiative (CalGRIP) to provide more than $48 million in state and federal funding for local antigang efforts, including prevention, intervention, enforcement, job training, and education strategies (Governor's Office of Gang and Youth Violence Policy 2010). CalGRIP also expanded the 20-unit pilot program in San Bernardino to an 80-unit program by adding 20 units each in five additional jurisdictions. This study focuses on HRGOs who are released from prison and placed on parole supervision with GPS monitoring in six* California jurisdictions. This group (n=407) includes all HRGOs placed on GPS monitoring technology from March 2006 through October 2009 in each of the six specialized gang units located in the City of Los Angeles and the following California counties: Fresno, Los Angeles, Riverside, Sacramento, and San Bernardino.

* The GPS supervision of HRGOs expanded to a number of other jurisdictions and then contracted due to budget considerations during the course of this study. This research focuses on the original six jurisdictions.

Propensity Score Adjustment

To identify comparison individuals likely to have pretreatment risk characteristics similar to those in the treatment group, a propensity score procedure was performed using a sample of offenders drawn from each of the same six communities that maintained specialized gang units, but who were not placed on GPS at the time of data collection. The initial sample included more than 145,000 records. This sample was narrowed down to nearly 11,000 subjects by eliminating duplicate records (15,324 records) as well as subjects who were a) paroled outside the 2006–09 time frame (10,576 records); b) paroled out of state (554 records); c) deported (14,237 records); d) paroled to a "nonrevocable" parole status (5,157 records); e) paroled to a unit outside of the study strictures (52,277 records); f) placed on parole with no conditions relating to gang membership or association (34,791 records); g) parolees with discharge dates before Jan. 1, 2009, because it was unlikely these Record of Supervision (ROS) files would be available (1,444 records); and h) parolees with a unit code designated as MNRP, an administrative code (383 records). This working sample included 10,963 subjects (407 treatment and 10,556 control subjects).

The working sample was used to match the treatment group with a similar group of control subjects using the STATA propensity score procedure PSMATCH2 (Leuven and Sianesi 2003). The PSMATCH2 implements full Mahalanobis matching and a variety of propensity score matching methods to adjust for pretreatment observable differences between a group of treated and a group of untreated subjects. Matching methods to choose from include one to one (nearest neighbor or within caliper; with or without replacement), k–nearest neighbors, radius, kernel, local linear regression, and Mahalanobis matching.

This study used the one-to-one nearest-neighbor method. The treatment group was matched on race, age, gender, admit status, controlling offense type, controlling offense severity, registration as a violent offender, narcotics offender or sex offender, drug and alcohol testing requirements, date of parole, and parole district. A propensity score was generated for each parolee. The PSMATCH2 program for STATA matched control and treatment group parolees to unique nearest neighbors whose propensity score was within a certain caliper.* Because parolees' were assigned a single match, the data were sorted randomly before the procedure was run. Parolees who could not be matched were dropped. The matching procedure resulted in a final sample of 784 subjects (392 treatment† and 392 control subjects). The two groups did not differ significantly on any variable.

Independent samples t–tests and chi-squared tests were run to investigate differences between the matched sample (n=784) and parolees who were not selected in the matching process (n=10,179). The matched sample had significantly fewer African American parolees, as well as fewer sex offender registrants. It was also significantly more male, Hispanic, and had more violent offender registrants. In terms of controlling offenses, the matched sample had significantly more violent and "other" offenses, and more charges, as well as significantly fewer drug and property offenses.

C. Data Sources

Once the treatment and control groups were established, we used six primary sources to collect data: 1) the CDCR data management system, 2) official arrest records, 3) parole supervision records, 4) GPS monitoring data, 5) a CDCR parole agent (PA) survey, and 6) CDCR cost information.

* We experimented with various calipers. We chose the caliper that resulted in the largest number of possible cases for analysis while eliminating selection biases in the variables included in the matching (i.e., there were no significant differences between the groups).

† The treatment group was slightly reduced (15 subjects) because there was no admit status in the data.

CDCR Data Management System

California operates a data management system that houses numerous databases relevant to the supervision of HRGO parolees. These databases include but are not limited to the Automated Release Date Tracking System, the Correctional Offender Management Profiling for Alternative Sanctions (known as COMPAS), Cal–Parole, the Parole Law Enforcement Automated Data System, the Revocation Scheduling Tracking System (RSTS), the Offender-Based Information System (OBIS), the Distributed Data Processing Systems, and the California Law Enforcement Telecommunications System. Most data used for this study were derived from three databases: Cal–Parole, RSTS, and OBIS. The Cal–Parole tracking system stores a variety of information on offenders released from prison and placed on parole, including birth date, gender, race, residency information, the date the parolee was released from prison, the date the parolee is scheduled to be discharged from parole, any special conditions linked to parole, and the unit and agent to which the parolee is assigned. RSTS stores a vast array of data regarding parole revocations, including information on the date and type of parole violation and the result of the parole revocation hearing. OBIS maintains a rich database of information concerning prior criminal history (date of arrest, arrest charges, disposition date, disposition charges, disposition, and length of sentence) for all adult offenders in California. A central feature of the California system is that offenders are linked across all three of these systems through a unique identifier that permits users to find the same individual in different contexts or data systems.

Official Arrest Records

Another principal data source for this study was the official record of arrests, convictions, and custody (commonly known as a RAP sheet) for each study subject. Official records are frequently used in research on recidivism. However, there are many methodological issues involved in assembling and interpreting data from RAP sheets. These sources of error include but are not limited to linking dispositions to arrests, false negative errors in arrest records, definitional problems in interpreting RAP sheets, handling events with multiple charges, and dealing with technical violations. To minimize such errors, researchers in this study worked closely with CDCR staff to correctly interpret RAP sheets. All records were manually entered into a database specifically developed for this study.

Parole Supervision Records

PAs maintain a record of supervision for each parolee under their supervision. Specifically, the PA notes the date and specific type of contact. A contact may be categorized as follows: a) initial interview, b) office, c) residence, or d) collateral contact. The ROS is stored only in hard copy format in the parolee's case file, which is typically located in the parole unit of record. Consequently, a set of site visits was conducted to obtain the record of supervision data from the PA case files. Again, all data were keyed directly into a database specifically developed for this study. These data were collected to measure the level of supervision received by each offender and to assess the California GPS program model.

GPS Monitoring Data

The GPS monitoring data were used to categorize subjects in groups as well as for descriptive purposes and to assess the California GPS program model. The GPS monitoring system into which HRGO parolees are enrolled was operated by two vendors (Satellite Tracking of People [STOP] LLC and 3M) during the course of this study.* STOP is used in the southern portion of California (Regions 3 and 4*), and 3M is

* It should be noted that CDCR recently discontinued its relationship with 3M and placed all parolees under the STOP LLC system.

responsible for the northern areas (Regions 1 and 2). While the terminology of the vendors differs, the capabilities of hardware and software are virtually identical. As described in chapter 1, each vendor employs an active monitoring system that combines cellular and GPS technology to automatically track the location of a parolee. Each vendor provided an assignment history for each parolee to indicate the date and time an offender was monitored with GPS technology. In addition, each vendor provided a record of each GPS event† (Inclusion Zone, Exclusion Zone, Battery, Strap/Device, Cell Communication Gap, and No GPS Communication) that included the event start and stop times and duration during a specified period.

CDCR Parole Agent Survey

The survey instrument was developed to collect process data from CDCR PAs. To facilitate comparisons between the two studies, it was adapted from the survey instrument used in the study of the CDCR GPS monitoring program for sex offenders (Gies et al. 2012). The final version of this survey contained questions in seven areas:

1. Program staffing
2. Agent information
3. Equipment issues
4. Caseload specifications
5. Enrollment and orientation
6. Collaborative engagement
7. General summary

The instrument was emailed to all PAs in August 2012. It was used to question PAs about core program components and administered in a Web-based format, in which an email was sent to agents by CDCR encouraging their participation. The email also contained a note introducing the anonymous Web-based survey, instructions for taking it, a link to the survey embedded within the text, and a password to securely access it. PAs were sent numerous requests to complete the survey throughout the month; the survey was closed at the end of September 2012. The request received 24 unique and eligible responses, a figure that roughly corresponds to the number of agents carrying gang-related GPS caseloads at the time of the survey. At that time, there were roughly 30 level 1 GPS PAs‡ with existing gang offender caseloads, yielding a good response rate (83.3 percent) for GPS PAs.

CDCR originally implemented six specialized gang units in the following California communities: Fresno, the City of Los Angeles, Los Angeles County, Riverside, Sacramento, and San Bernardino. Subsequently, during the course of this study, CDCR first added (due to the high number of gang offenders under supervision) then withdrew (due to budget concerns) several specialized gang units.§ Overall, the survey provided a good representation of the GPS PAs (see table 4.1 in chapter 4). An analysis of the survey data

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* CDCR is organizationally and operationally divided into four distinct regions, with numerous districts within each region and numerous parole units within each district. Region 1 consists of the Central Valley, ranging from Bakersfield to the Oregon border, while Region 2 encompasses the coastal counties from Ventura to the Oregon border. Region 3 includes only Los Angeles County, and Region 4 consists of the southern counties of Imperial, Orange, Riverside, San Diego, and San Bernardino.
† GPS event data for the study period were available from a single vendor (i.e., STOP). The second vendor (i.e., 3M) was unable to provide the data at the date of publication (n=281). Although 3M provided a file designated to include event data, the majority of this data was missing. Efforts are ongoing to retrieve this data from 3M.
‡ Level 1 PAs directly supervise parolees.
§ The sample in this study is restricted to the original six specialized gang units.

by district suggests the volume of responses favored the regions* encompassing the original six specialized units, with Region 1 representing 29 percent of respondents, Region 2 representing 16 percent of respondents, Region 3 representing 29 percent of respondents, and Region 4 representing 25 percent of respondents. Notably, Region 3 (Los Angeles County) is the smallest geographic unit. The distribution across the original six districts was comprehensive, with at least two responses (most have many more) from each of the parole districts.

Cost Information

The cost information elements used in the analysis are grouped into four broad categories: 1) personnel (all fulltime and parttime staff and consultants), 2) facilities (i.e., the physical space required for the program), 3) equipment and materials (furnishings, instructional equipment, etc.), and 4) other inputs (all remaining costs that do not fit into the other categories). This information was obtained through communications with CDCR staff and a review of budget documents. A cost-effectiveness analysis worksheet was developed that divided all cost elements into one of the four broad categories. This worksheet was transmitted to CDCR by electronic communication with a request to add the monetary values to each category along with explicit instructions to add any cost element that was missing from the initial draft. Follow-up discussions by electronic communication were used to refine cost elements and associated monetary values. For verification and to correct the cost elements, a final version of the worksheet was transmitted to a CDCR budget analyst.

D. Measures

Outcomes

The two main outcomes of interest were noncompliance and recidivism. Noncompliance was operationalized as violations of parole. CDCR tracks numerous different types of prohibited parolee behavior that can be divided into technical and nontechnical violations. Technical violations refer to behavior by an offender under supervision that is not by itself a criminal offense and generally does not result in arrest. This type of non-criminal behavior includes absconding, access to weapons, association with known gang members, and various other violations of the parole process. Nontechnical violations refer to behavior that constitutes a new criminal offense. Nontechnical violations can range from less serious types of violations such as drug possession to very serious violations such as assault, rape, and homicide. This study examines both types of violations. The data were obtained from the CDCR Data Management System. Recidivism, on the other hand, was operationalized as an arrest for a new crime. The distinction between a nontechnical violation and a new arrest is the method of processing the event. Specifically, parole violations are processed through a parole board hearing while a new arrest is processed through traditional court proceedings. Arrest data were obtained from official records (RAP sheets). Each outcome was measured in terms of the month the event occurred. Each subject was tracked for 2 years after the initial parole date (month 1 through 24).

Independent and Control Variables

The main variable of interest was the use of GPS monitoring (i.e., GPS status). Group differences between GPS and control condition subjects were minimized on a range of pretreatment characteristics, including sociodemographic and criminal history measures through the use of the aforementioned propensity score

* CDCR is organizationally and operationally divided into four distinct regions, with numerous districts within each region and numerous parole units within each district. Region 1 consists of the Central Valley, ranging from Bakersfield to the Oregon border, while Region 2 encompasses the coastal counties from Ventura to the Oregon border. Region 3 includes only Los Angeles County, and Region 4 consists of the southern counties of Imperial, Orange, Riverside, San Bernardino, and San Diego.

adjustment procedure. However, subsequent analyses of the arrest and custody data (only collected and coded for treatment and control subjects subsequent to the matching procedure) revealed statistically significant differences between the groups in terms of the number of drug and weapons arrests. Thus, these two control variables were added to the model.

GPS STATUS. The main variable of interest is the use of GPS monitoring (i.e., GPS status). Unlike with sex offenders in California, there is no legislative mandate to supervise gang offenders with GPS monitoring. In other words, CDCR has the discretion to use GPS monitoring with any offender released onto parole who is eligible under the Gang Eligibility Assessment Criteria. Parolees eligible for the specialized gang caseload can go on and off the caseload (and thus GPS monitoring) at any time while on active parole, depending on the caseload demand of the parole unit and discretion of the unit supervisor.

As a result, GPS status is measured in two ways. First, it is measured dichotomously, by noting group membership (0=control group; 1=GPS group) as a continuous or static variable. The GPS group includes HRGOs who received traditional parole supervision plus placement on GPS monitoring technology, while the control group includes HRGOs who received only traditional parole supervision during the study period.* This measurement specification takes an ITT approach, where all offenders who were assigned to GPS supervision are considered to be part of the GPS group, regardless of whether the parolee received the "treatment." In general, an ITT approach offers a more conservative estimate of the treatment effect, for a subject may be arrested while removed from GPS, but still assigned to the GPS group.

Discrete-time event history (survival) models offer a convenient and intuitive way of incorporating both repeated events and time-varying covariates into models. The approach begins by creating a person (parolee) X time (i.e., month) data set. Such an approach naturally lends itself to adding repeated events (e.g., arrests) as well as explanatory variables that are constant but may vary in their effect over time (i.e., may have a greater or lesser effect over time) or that actually vary over time (i.e., change values over time). To begin the analyses, we first calculated an at-risk variable that indicated whether within any given month, the offender was at risk of an event occurring (i.e., arrest or parole violation). If the offender was "on the street" at any point during the month, the at-risk variable was coded 1; if the offender was in CDCR custody for the entire month, the at-risk variable was coded zero. This variable was used to "censor" (code as missing) offender months in which the offender was not at risk of experiencing the event. It allowed us the ability to create a person X time data set that allowed the predication of the likelihood of an event occurring when an individual was at risk of having that event occur.

OTHER MEASURES. A good deal of literature suggests unstable environments are associated with criminal recidivism (Walters 2003, Davies and Dedel 2006, Tille and Rose 2007). The CDCR maintains data on the point at which offenders change their location of residence. We calculated the number of moves offenders made in any given month and used this as a time-varying independent variable to predict arrest and parole violations.

* Although this approach makes group comparisons straightforward, the real-world management of high-risk offenders in the community did not result in a clean delineation between the groups. The GPS tracking data revealed that 42 offenders (10.7 percent) assigned to the treatment group, while exposed to GPS monitoring during the parole period, did not receive GPS monitoring during the two-year tracking period following the current release from custody event. In addition, CDCR placed 21 (5.4 percent) of control group offenders on GPS monitoring subsequent to the group assignment for the study.

E. Statistical Overview

Missing Data

No baseline item included in the propensity score matching procedure contained missing data. The demographic information described in the matching procedure was collected for all subjects. In addition, while the official records did not contain out-of-state and juvenile criminal histories, these events were corroborated in other CDCR data sources. Thus, all subjects were confirmed to have been previously arrested, convicted, and placed in prison at least once.

Treatment Outcome Analyses

A series of analyses was performed in sequential phases to assess the impact of the CDCR GPS supervision program. The first phase of analyses explored the differences (or lack thereof) between groups in numerous pretreatment characteristics, as well as outcomes at baseline. Independent samples t–tests were used to test for significance between the groups.

The second phase assessed the impact of the GPS program on each measure of recidivism. Here we used a survival analysis model to predict time until each event. In a discrete-time model, time is treated not as a continuous variable but as divided into discrete units or chunks (e.g., weeks, months, years). The model is characterized by few possible survival (or censoring) times, with many people sharing the same survival time (Rabe–Hesketh and Skrondal 2008).

Discrete-time analysis is common in social and behavioral science applications because it can easily accommodate both time-constant and time-varying covariates (i.e., covariates that change between the time a person becomes "at risk" and experiences the event) (Muthén and Masyn 2005). For instance, continuous-time models are predicated on the often unrealistic assumption that the effect of a covariate on event occurrence is constant over time (Singer and Willet 1993). Yet in criminological research, the effects of covariates such as marital status and employment may vary over time, with the risk of reoffending lower during periods of marriage and employment compared with periods of separation and unemployment. Finally, discrete-time models do not require a hazard-related proportionality assumption that is commonly used in continuous survival analysis. Instead, they become models for dichotomous responses when the data are expanded to person–period data. Logit and probit models can then be used, as well as complementary log–log models (Rabe–Hesketh and Skrondal 2008).

Repeated Events. Up to this point, only nonrepeatable events have been discussed. However, in longitudinal research, an event may occur more than once throughout an individual's lifetime. For example, a subject may be arrested, go to prison for a specified duration, and then return again to the community—at which point the subject is again at risk for arrest. In such a case, the durations between events may be correlated because of the presence of unobserved individual-level factors. Repeated events are usually handled by including individual-specific random effects in an event history model, pointing to the requisite for a multilevel modeling approach. The discrete modeling approach we chose is also amenable to modeling repeated events.

Clustering. Parolees are monitored by agents who operate within an explicit parole district, creating clusters of subjects. In other words, each parolee is clustered or nested within a parole district. In clustered data, it is usually important to allow for dependence or correlations among the responses observed for units that belong to the same cluster (Rabe–Hesketh and Skrondal 2008). For example, in the present application, it is possible that recidivism outcomes for parolees from the same parole district

are correlated because parolees have been supervised within the political and regulatory environment of the same district. To account for the data clustering, random-effects models (also called multilevel, hierarchical linear, or mixed models) provide a useful approach for simultaneously estimating the parameters of the regression model and the variance components that account for the data clustering.

MODEL. In this study, we use multilevel discrete-time survival models, where random effects, often called frailties in this context, are included to handle the unobserved heterogeneity between clusters and within-cluster dependence (Rabe–Hesketh and Skrondal 2008). That is, to accommodate dependence among survival times of parolees within the same district, after controlling for observed covariates, a random intercept is included for each district. The frailty approach provides a means to examine heterogeneity among subjects and to estimate the distribution of subsequent failure time with the use of failure times and covariate information from other members in the cluster. For these reasons, frailty models have been widely used for the analysis of clustered survival data (Hougaard 1995, Duchateau and Janssen 2008). Discussions on the use of frailties models can be found in Hougaard (2000), Therneau and Grambsch (2000), and Wienke (2010).

Specifically, the observations of the district measure with equal value are assumed to have shared (the same) frailty. Across groups, the frailties are assumed to have a Gumbel distribution commonly found in survival and event history analyses. According to Rabe–Hesketh and Skrondal (2012: 782) "the standard Gumbel distribution has a mean of about .577 (called Euler's constant) and a variance of $\pi^2/6$, and is asymmetric."In the present application, we specify a random-intercept complementary log–log model using the xtcloglog command in STATA with a shared frailty option. This model is appropriate due to our use of interval-censored survival times (and as a proportional hazards model would hold in continuous time). These models include dummy variables for each period and do not include a constant. As discussed above, a shared frailty is specified by parole district. The resulting exponentiated coefficients produced by these models "can be interpreted as hazard ratios in continuous time" (Rabe–Hesketh and Skrondal 2008, p. 356).

The next chapter examines the results of these analyses.

3. Results

A. Baseline Characteristics

Several demographic and baseline characteristics of the sample are displayed in table 3.1. In addition, the groups were compared on parole district to account for the geographic diversity of the State of California.

Table 3.1. Comparison of Baseline Characteristics: GPS and Control Groups

Measure	Control Group	GPS Group	T–Value
Sex			
Male	99%	99%	.379
Race			
African American	28%	29%	-.238
Hispanic	58%	59%	-.362
White	9%	8%	–1.33
American Indian	1%	1%	.000
Other	4%	3%	.769
Age at Parole			
Age	29.03 yrs	28.70 yrs	.648
Controlling Offense			
Violent	36%	36%	.000
Drug	23%	22%	.511
Property	14%	15%	-.411
Other	27%	27%	-.161
Registrations			
Narcotics Register	38%	.35%	.891
Drug Testing	85%	84%	.391
Alcohol Testing	23%	21%	.687
Violent Offender Register	19%	18%	.367
Arrest[a]			
Any Arrest	11.88	11.43	.906
Violent Arrest	2.92	2.78	.798
Drug Arrest	3.54	2.95	2.10*
Weapons Arrest	1.64	1.91	-2.28*
Gang Arrest	.265	.337	-1.67
Property Arrest	3.25	3.15	.454
Prior Custody[b]			
Days in Prison	1,522	1,681	–1.51
Custody Events	3.69	3.90	-.801
Offender Status			
New Admit	55%	55%	.072
Other	45%	45%	-.072

Note: Sample size: GPS group=392; control group=392. [a]Juvenile arrests are not included in the analysis. One subject had a single juvenile arrest and no adult arrests. The subject was coded as having 0 prior arrests. [b]Custody includes only prison events (i.e., jail events are excluded). Eight subjects were sentenced to a custody term but awarded time served and subsequently spent 0 days in CDCR custody.
* $p < .05$; ** $p < .01$; *** $p < .001$.

While there were no significant differences in the baseline characteristics used in the propensity score matching procedure, some data were unavailable electronically and could not be collected for each offender until the sample was tapered to a manageable scope. For instance, after the introduction of arrest history, it was noted that there were small but significant differences between the treatment and control groups in terms of prior drug arrests and prior weapons arrests. Specifically, the GPS group tended to have more prior drug arrests in their criminal history, while the control group tended to have more prior weapons-related arrests. Considering the population being researched in this study includes high-risk gang offenders (HRGOs), it is very likely that these differences are due to chance. However, in order to account for all group differences, all multivariate models include time constant covariates for prior drug arrests and prior weapons arrests.

Gender, Race, and Age

Overall, the sample was 99 percent male and consisted of more Hispanic offenders (59 percent) than any other race, but also included substantial proportions of African American (28 percent) and white (8 percent) offenders. The vast majority of offenders (60 percent) were between 21 and 30 years old (see table 3.2). The mean age of the full sample was 29 years at the time of parole. There were no statistically significant differences between the groups in any of these characteristics.

Table 3.2. Comparison of Age at Parole: GPS and Control Groups

Measure	Control Group	GPS Group
Age		
<20	6.4%	8.2.%
21–25	32.4%	26.0%
26–30	27.3%	33.4%
35+	33.9%	32.4%

Note: Sample size: GPS group=392; control group=392. No significant differences.

Prior Arrests

Table 3.3 demonstrates an overall long history of criminal behavior among the subjects in the study. The data indicate that only 18 percent of the full sample was arrested less than six times before the start of the study period, with 34 percent arrested 6 to 10 times previously. In fact, nearly half (48 percent) was arrested 11 or more times, with nearly one fourth (24.1 percent) arrested 15 or more times. Overall, the sample was, on average, arrested about 12 times previously. There were no statistically significant differences between the groups in any of these characteristics.

Table 3.3. Comparison of Prior Arrests: GPS and Control Groups

Measure	Control Group	GPS Group
Arrest Events		
1–5	16.8%	18.1%
6–10	33.4%	34.2%
11–15	25.0%	24.2%
15+	24.7%	23.5%

Note: Sample size: GPS group=392; control group=392. Juvenile arrests are not included in the analysis. One subject had a single juvenile arrest and no adult arrests. The subject was coded as having 0 prior arrests. No significant differences.

Prior Custody

An examination of prior custody events further confirms the frequency with which the sample subjects participate in criminal activity. Table 3.4 shows that nearly two thirds (62 percent) of the sample had been in prison more than once prior to the study period, with nearly 40 percent incarcerated more than four times previously. Overall, the sample was, on average, incarcerated 2.5 times previously for 1,602 days before being paroled into our study. There were no statistically significant differences between the groups in any of these characteristics.

Table 3.4. Comparison of Prior Prison Events: GPS and Control Groups

Measure	Control Group	GPS Group
Prison Events		
1	38.8%	37.8%
2	13.5%	13.5%
3	9.7%	8.7%
4+	38.0%	40.1%

Note: Sample size: GPS group=392; control group=392. Custody includes only prison events (i.e., jail events are excluded). Eight subjects were sentenced to a custody term but awarded time served, and subsequently spent 0 days in CDCR custody. No significant differences.

Controlling Offense and Registrations

Not only did offenders in the sample demonstrate an elevated number of arrests and custody events, but an analysis of the controlling offenses and registrations indicate a proclivity for serious and violent behavior. The controlling or primary offense is designated by the court as the base term—usually the offense that keeps the offender in custody for the longest period of time. Overall, the data indicate that the largest proportion (36 percent) of the sample was placed in custody for violent offenses. Offenders were also placed in custody for drug (23 percent), property (14 percent), and a range of other offenses (27 percent). The most frequent condition of parole was drug testing, which was a condition for 84 percent of the sample, with 22 percent having to submit to alcohol testing. Moreover, 36 percent and 19 percent of the sample were required to sign on to the narcotics and violent offender registry, respectively. There were no statistically significant differences between the groups in any of these characteristics.

Summary

The previous tables provided information on several pretreatment characteristics of the sample. The group comparison of these characteristics indicates that the two groups are very similar. In fact, the only significant differences are that the control group had a greater number of subjects with prior drug arrests. Conversely, the GPS group had a greater number of subjects with weapons-related arrests.

B. Record of Supervision (ROS)

Parolees are released into the community under very specific conditions, which often include requirements such as obeying the law, refraining from drug and alcohol use, avoiding contact with the parolee's victims or other gang members, obtaining employment, and maintaining required contacts with a parole agent (PA). To optimize the level of supervision for a population of HRGOs, CDCR standardized the minimum number of specific contact types to which PAs are required to adhere (see chapter 5 for more details on adherence). Specifically,

- A PA assigned a specialized gang caseload MUST conduct a minimum number* of face-to-face contacts with the parolee each month.

* The exact number is known to the researchers. However, at the request of CDCR and to preserve the integrity of the parole program, this figure is omitted from the final report.

- A PA assigned a specialized gang caseload MUST conduct a minimum number* of collateral contacts per month.
- A PA assigned a specialized gang caseload MUST conduct a minimum number* of random drug tests each month.
- A supervisor MUST conduct a case conference review a minimum number* of times each year.

Table 3.5 provides a comparison of the control and GPS groups in terms of supervision level. For each contact type, the table displays the rate of contact per month (adjusted for the number of days under supervision) for both the offenders who received GPS supervision and those who received traditional parole supervision. A face-to-face contact is any visit or contact in which the PA meets directly with the parolee. As such, the initial interview, office visits, and residence visits are all considered face-to-face contacts. Collateral contacts are any contacts in which the PA checks up on the parolee indirectly through family, friends, associates, and neighbors. In addition, drug tests are performed during office visits and case reviews are conducted by parole unit supervisors. Both supervision activities are designed as additional safeguards to ensure parolees are adhering to established guidelines.

While every effort was made to locate and code the ROS file for each subject in the study to control for supervision, approximately 42 percent of the sample (326 subjects) were missing ROS records. The reasons for these missing data varied, but the majority were no longer available because parole administrators either purged the data from the file after a return-to-custody event or completely destroyed the entire file shortly after discharge. Nevertheless, for those subjects whose ROS information was obtained, the data demonstrate a significantly greater number of face-to-face and collateral contacts and drug tests for the GPS group compared with control group subjects. For instance, agents meet face to face with GPS parolees on average almost two times (1.84) per month compared with 1.54 times per month for non-GPS parolees. These findings suggest the GPS group received an overall higher level of supervision compared with subjects in the control group.

Summary

Table 3.5 provides information on the supervision of HRGOs in California. The group comparison of these supervision elements indicates that (perhaps not surprisingly) subjects in the GPS group are supervised more closely than the control group in terms of face-to-face and collateral contacts. In addition, agents appear to more diligently review the case file of offenders placed on GPS monitoring compared with agents who have traditional offenders. In short, while CDCR PAs attempt to strictly monitor known gang offenders on parole, the activities embedded within the structure of the GPS monitoring program necessitate more supervision.

In theory, the level of supervision is an important variable as it relates to recidivism, because offenders who are monitored more closely in the community are less likely to engage in illegal behavior. Thus, one may want to include a measure of supervision in a model predicting the effect of GPS supervision on recidivism. In practice, however, this may not always be the case. A recent study by the Urban Institute found parole supervision has little effect on rearrest rates of released prisoners. Specifically, the study found mandatory parolees fared no better on supervision than similar prisoners released without supervision. In fact, in some cases they fared worse (Solomon, Kachnowski, and Bhati 2005).

More problematic for this study, the level of supervision is likely directly related to the effect of GPS supervision, as simply being placed on GPS monitoring necessitates more contact between agent and

Table 3.5. Comparison of Supervision Record: GPS and Control Groups

	Contacts per Month[a]		
Contact Type	Control	GPS	T–Value
Supervision			
Face to Face	1.57	1.84	-3.51***
Collateral	1.05	1.25	-2.90***
Total (Face and Collateral)	2.62	3.09	-3.48***
Drug Test	.69	.076	-1.89
Case Review	.23	.28	-2.27*

Note: n=458: 211 control, 247 GPS; 326 subjects (42 percent) were excluded from the supervision analysis because of the unavailability of ROS data. ROS data are often purged from the file after a return-to-custody event and completely destroyed shortly after discharge from parole.
[a]The number of contacts divided by the number of days in the community.
* p < .05; ** p < .01; *** p < .001

offender. The increased contact comes in many forms, ranging from innocuous maintenance issues and equipment failure to the investigation of parole violations directly related to GPS monitoring (e.g., zone or curfew violations). These interactions are not a form of more intensive supervision, but rather intricately intertwined into the operation of the GPS program, where controlling for the level of supervision may actually remove a portion of the GPS program effect.

Given the inconclusive nature regarding supervision and the inability to disentangle the effect of traditional supervision and GPS supervision, we do not attempt to control for it here.

C. Outcome Analysis

Studies of criminal behavior typically use one or more of the following three measures to assess reoffending:

- Violation of parole
- Rearrest
- Return to prison custody

These measures are indicators of the occurrence of offending behavior. Each has strengths and weaknesses. Violations of parole typically used to measure parolee noncompliance may or may not constitute a new crime because offenders may commit acts that violate only the technical aspects of parole (i.e., missing an appointment with a PA). It should be noted that as part of their parole, gang members often receive special conditions not to associate with certain persons, typically known associates, and other gang members. Violations of this rule, "associating with persons prohibited" are deemed to be technical parole violations. This specificity makes technical parole violations a more interesting outcome for the population of interest to this study. Arrests are the most popular and convenient measure of crime available, but an arrest does not prove a new offense actually occurred, as occasionally the charges against an offender are dropped and the offender is released without further incident. In addition, arrests account only for crimes that have been detected by law enforcement. Finally, a return to custody is the narrowest measure of recidivism, as it accounts for only the most serious crimes and violations that result in a prison term. This report uses measures of technical parole violations, nontechnical parole violations, arrests, and arrests for violent offenses to assess the offending behavior

of HRGO parolees. It also provides descriptive statistics for the sample's return to custody during the study period, the analysis of which will be featured in a forthcoming follow-up report.

Descriptive Statistics

Before running the discrete-time analysis models, the raw outcome data is described and summarily assessed using chi-squared tests to look for group differences in categorical data. These are shown in Table 3.6.

When considering parole violations, this study assesses technical and nontechnical parole violations separately. As discussed above, an outcome of interest to this particular population is the technical parole violations, which would document (among other violations) infringements to restrictions on a parolee's association with other known gang members. As shown in table 3.6, there were similar proportions of parolees in both conditions experiencing such a violation in their 2 years from release to parole, with 42.6 percent for the control group and slightly more (43.9 percent) for the GPS group. While these differences were not significant, we can hypothesize that the GPS surveillance may help increase detection of technical infringements, in particular when attempting to establish a person's whereabouts (e.g., determining they spent some time in the home of a known gang member). In terms of nontechnical parole violations, more than half of both conditions experienced such an event in their 2 years post-release to parole, with 53.9 percent for the GPS group and slightly more, 54.9 percent, for the control group. These differences were also not significant.

When looking at arrests during the study period, 46.7 percent of the GPS group was rearrested at least once, compared with 56.1 percent of the control group. The chi-squared test shows the treatment group was significantly less likely to be rearrested than the control group [$X^2(1, n=784) = 6.99$, $p<.01$]. These effects can also be seen in the arrests for violent offenses, with the GPS group experiencing fewer arrests for violent behavior (12.5 percent) compared with the control group (19.6 percent) during the 2 years following their release from prison. Similarly, these group differences were also statistically significant [$X^2(1, n=784) = 7.41$, $p<.01$].

Finally, in terms of a return to custody during the 2 years after their release from prison, we note 79.3

Table 3.6. Comparison of Outcomes: GPS and Control Groups

	Experience of the Event during the Study Period		
Event Type	Control	GPS	Chi-Square
Technical Parole Violation	167 (42.60%)	172 (43.88%)	.1299
Nontechnical Parole Violation	215 (54.85%)	211 (53.83%)	.0823
Arrest	220 (56.12%)	183 (46.68%)	6.9902**
Arrest for a Violent Offense	77 (19.64%)	49 (12.50%)	7.4137**
Return to Custody	272 (69.39%)	311 (79.34%)	10.1761***

Note: n=784: 392 control and 392 GPS parolees.
* p < .05; ** p < .01; *** p < .001

percent of the GPS group was reincarcerated compared with 69.4 percent of the control group. These differences were shown to be statistically significant [X^2(1, n=784) = 10.18, p=.001]. This is somewhat surprising in view of fewer treatment parolees rearrested in general and rearrested for a violent offense; however, we can hypothesize that this difference may be related to the increased ability to detect and investigate crimes and parole violations using GPS tracking technology. This particular aspect of the program, as well as a discrete-time survival analysis of the return to custody finding, will be the subject of a forthcoming follow-up report.

These findings, however, only measure if an event occurred at least once during the study period for the parolees. They do not measure the number of times the events occurred, nor do they account for a number of observable independent variables that may moderate or contribute to these rates. In the following section, discrete-time survival analyses, in the form of random-intercept complementary log–log models, are used to assess the hazard of recidivism for the GPS intervention for arrest and parole violation outcomes.

Results of Discrete-Time Survival models

Each outcome is assessed using multilevel discrete-time survival models, controlling for the geographic mobility during the study period, prior weapons offenses, prior drug offenses, and the district into which gang offenders are paroled using a shared frailty approach (to accommodate dependence among the survival times of parolees within the same district). (See chapter 2 for a detailed description of each measure.) Before running multivariate models, the dataset is declared to be panel data using the unique parolee identifiers, and months, ranging from 1 to 24, as the time variable. As per discrete-time survival analysis design, the model includes dummy variables for each of the 24 months from the subjects' release from prison.

The outcomes are modeled in a random-intercept complementary log–log model and produce output in terms of regression coefficients, which, when exponentiated as reported here, can be interpreted as hazard ratios (Rabe–Hesketh and Skrondal 2008). The hazard ratio is an estimate of the differential rate of a recidivism event for the GPS group compared with the control group. It should be noted that four subjects died during the study period. Their outcome data is censored after their death as they are no longer at risk of a recidivism event.

Technical and Nontechnical Parole Violations

We focus first on technical and nontechnical violations of parole, shown in table 3.7. In contrast to the bivariate analyses, more robust multivariate models indicate that in both cases GPS is associated with a greater likelihood of experiencing parole violations. The odds of a technical violation are 36 percent greater among the treatment group, while the odds of a nontechnical violation are 20 percent greater. In terms of control variables, geographic mobility (a time-varying independent variable), is as expected, positively associated with both technical and nontechnical violations. In addition, prior drug arrests are not associated with technical violations, but are significantly and positively associated with nontechnical violations. This is unsurprising, as drug possession and drug use (as measured by mandatory narcotics testing) are considered nontechnical parole violations. Prior weapons arrests are not associated with technical or nontechnical parole violations.

Table 3.7. Multivariate Random-Intercept Complimentary Log–Log Models for Technical and Nontechnical Parole Violations

	Technical Violation		Nontechnical Violation	
Variables	Exp β	SE	Exp β	SE
GPS	1.364***	.091	1.203**	.079
Moves	1.291**	.117	1.341**	.117
Prior Drug Arrest	1.013	.009	1.038***	.008
Prior Weapons Arrest	.994	.021	1.038	.020
	Log-likelihood: -3,512.91		Log-likelihood: -10,534.811	
N = 784 over 24 months	Wald chi-square: 714.48(28)***		Wald chi-square: 780.51(28)***	

Note: These models include 24-month dummy variables (no constant), and a shared frailty by parole district.
* p<.05; ** p<.01; *** p<.001

Not presented in the table are 24 dummy variables (with no constant) representing the hazard of a technical parole violation for each of the 24 months of the study. While interesting and potentially important, these coefficients are not presented, as the tables would become unwieldy. For technical violations, the coefficients are all statistically significant but relatively small and consistent (i.e., ranging from .04 to .06). The hazards ratios for nontechnical violations are much larger and much more varied ranging from .03 to .32. There are various interpretations of this finding, but it appears nontechnical violations start relatively small (exp β = .03) and grow more or less linearly to about month 9 (exp β .32) and taper off to the mid .20s thereafter. It is unlikely that this effect is due to procedural changes unless there is a concerted effort to focus attention on offenders as they progress on parole. That is, since parolees are released at different dates, this systematic change is likely not related to programmatic or policy effects put in place at a certain time. Rather, the effect is likely due to variations in parolee behavior that changes over time.

We next focus on overall arrests and arrests for violent crimes, presented in table 3.8. In contrast to the positive effect of GPS on parole violations, the treatment group (GPS) is less likely to be rearrested overall (the chance of being rearrested is 26 percent lower) and for violent crimes (32 percent lower). Among the control variables, the only substantive effect was for prior arrests for drug offenses predicting overall arrests. For overall arrests, the month variables, not presented in the table, are all statistically significant but small, ranging from .02 to .07, showing no systematic variation over the two-year period. As true by definition, the chances for violent arrests are even smaller, ranging from .004 to 0.4.

Table 3.8. Multivariate Random-Intercept Complimentary Log-Log Models for Overall Arrests and Arrests for Violent Offenses

	Arrests		Violent Arrests	
Variables	Exp β	SE	Exp β	SE
GPS	.842*	.063	.675*	.108
Moves	.960	.119	1.006	.256
Prior Drug Arrest	1.033**	.008	1.005	.019
Prior Weapons Arrest	1.027	.022	1.060	.049
	Log-likelihood: -2,939.22		Log-likelihood: -886.41	
N = 784 over 24 months	Wald chi-square: 1416.41(28)***		Wald chi-square: 2340.21(28)***	

Note: These models include 24-month dummy variables (no constant), and a shared frailty by parole district.
* p<.05; ** p<.01; *** p<.001

Summary

The results are mixed but reasonable. While speculative, the multivariate models suggest the GPS group is significantly more likely to be violated for both technical and nontechnical conditions of their parole. Presumably, this is the result of the greater restrictions offenders placed on GPS receive, and the increased ability of PAs to detect violations. The higher levels of supervision discussed in section B above may explain these disparities. Alternatively, offenders placed on GPS are significantly less likely to be arrested overall, especially for violent offenses. This is an important finding confirming the bivariate results and controlling for periods at risk of being arrested, other individual predictors of recidivism, and the district into which offenders were paroled. Moreover, these are very conservative tests based on an intent-to-treat model, where the experimental group was not always on GPS when they were at risk of violating conditions of their parole or being rearrested.

D. Cost Analysis

This section performs a cost effectiveness (CE) analysis based on the findings above to ascertain which program alternative (GPS monitoring supervision or traditional supervision) can achieve the most efficient result (i.e., the most effective outcome at the lowest cost). The underlying assumption is that different program alternatives are associated with different costs and different results. By choosing those with the lowest cost for a given outcome, policymakers can use their resources more effectively (Levin and McEwan 2001).

The basic technique of CE is to derive results for the effectiveness of each alternative by using standard evaluation procedures (Rossi and Freeman 1985) and to combine such information with cost data derived from the ingredients approach to provide a systematic way for evaluators to estimate costs of social interventions (Levin 1983). The strength of this approach lies in its simplicity. Most important is that it merely requires combining cost data with effectiveness data that are ordinarily available to create a CE comparison. Further, it lends itself well to an evaluation of alternatives being considered. The major disadvantage is that one can compare costs only among alternatives with similar goals. Fortunately, this drawback does not have any bearing on the current study, as both alternatives focus on noncompliance and recidivism.

The costs of an intervention are defined as the value of the resources dedicated to an intervention. These are referred to as the ingredients of the intervention, and it is the social value of these ingredients that

constitute overall cost. The ingredients approach entails three distinct phases:

1. Identification of ingredients
2. Determination of the value or cost of the ingredients and overall costs of an intervention
3. An analysis of the costs in an appropriate decision-oriented framework

Step 1. Identification of Ingredients

The first step in applying the ingredients method is to identify ingredients used to generate and manage the program. In other words, every ingredient used to produce the effects that are captured in the evaluation must be identified and included in the cost calculation. As suggested by Levin and McEwan (2001), we divided the potential ingredients into four broad categories that have common properties to facilitate the identification and specification of each cost. These categories were 1) personnel (all fulltime and parttime staff and consultants), 2) facilities (i.e., the physical space required for the program), 3) equipment and materials (furnishings, instructional equipment, etc.), and 4) other inputs (all other costs that did not fit into the other categories). The primary sources for such data are written reports, observations, and interviews. Consequently, we reviewed documents and communicated electronically with CDCR staff to document the program elements associated with both the GPS supervision program and traditional supervision alternative. Specifically, a CE analysis worksheet was developed that divided all cost elements into one of the four broad categories. This worksheet was transmitted to CDCR by electronic communication with a request to add the monetary values to each category along with explicit instructions to add any cost element that was missing from the initial draft. Follow-up discussions by electronic communication were used to refine cost elements and associated monetary values. To verify and, if necessary, correct each of the cost elements, a final version of the worksheet was transmitted to a CDCR budget analyst.

Step 2. Determination of the Cost of Ingredients and Overall Costs of the Intervention

Once the ingredients have been identified and stipulated, it is necessary to ascertain their value or costs. Again, the primary sources for these data were written reports and communications with CDCR staff to document costs associated with each ingredient of the GPS supervision program and traditional supervision alternative. Table 3.9 provides a breakdown of the cost of each ingredient category as well as the subingredient category. The personnel category (approximately $2.5 million) was estimated by obtaining expenditures on salaries and fringe benefits as well as overtime costs. Because agents with a specialized gang offender caseload are absorbed into existing units, the facilities category ($151,000) was calculated at the individual level by allocating each agent 225 square feet of office space (itemized in the California outlay specifications) at $2.50 per square foot, as well as an estimation of the office supplies used during routine program operation. The equipment and supplies category ($32,000) concentrated on the GPS supervision–related equipment used by PAs*. In cases where the equipment was leased, the leasing value was obtained to estimate the annual cost value. In cases where the equipment was purchased, the cost was annualized over a typical length of use. For instance, a typical laptop computer costs about $2,500. It was estimated that the laptop would be functional for 5 years at an annualized rate of .2310. Consequently, the annualized cost of laptops for 20 agents is about

* While all agents have access to computers and other professional equipment, agents with a specialized gang caseload are afforded distinctive equipment to perform the unique duties of the job. Among this specialized equipment is a cell phone with extensive data plans to be alerted of GPS violations. Unlike their sex offender counterparts, however, GPS agents with specialized gang caseloads do not utilize hand-held GPS units for specialized field work.

Table 3.9. Costs of GPS and Traditional Parole Supervision		
INGREDIENTS	**GPS**	**TRADITIONAL PAROLE**
Personnel	**$2,423,420**	**$969,368**
HRGO Agents	$2,312,060	$924,824
Agent Overtime	$111,360	$44,544
Facilities	**$151,400**	**$70,400**
Office Lease	$135,000	$54,000
Accessories (phones, data, etc.)	$16,400	$16,400
Equipment and Supplies	**$30,750**	**$11,550**
Installation Supplies	$0	$0
Chargers	$0	$0
Straps	$0	$0
Units	$0	$0
Cell Phone	$19,200	$0
Laptops/Desktops	$11,550	$11,550
Other Inputs	**$575,969**	**$0**
Training	$58,920	$0
Training Supplies	$209	$0
Data Contract Management	$430,700	$0
Cost	**$3,094,971**	**$1,051,318**
Subsidies	**$0**	**$0**
User Fees	$0	$0
Other	$0	$0
Net Cost	**$3,094,971**	**$1,051,318**
Number of Parolees	**400**	**400**
Number of Agents	**20**	**8**
Cost (per parolee)	**$7,737**	**$2,628**
Cost (per parolee) (per day)	**$21.20**	**$7.20**
Equipment (per parolee) (per day)	**$2.95**	**n/a**

$12,000. Finally, the "other inputs" category includes $430,700* for provision of GPS services by the vendor. This figure includes the provision of hardware, software updates, staff hours, and assistance with technical aspects of supervision, including the monitoring center. Each of these ingredients is added to

* The full contract with the GPS provider is about $8 million annually. The cost of the GPS monitoring service is calculated at $2.95 per offender per day. This figure is all inclusive, including hardware, software updates, staff hours, and any special requests. Consequently, the contract is prorated for 400 gang offenders (6 percent of all GPS–monitored offenders).

the cost of the GPS program, as well as the traditional supervision alternative* (where applicable).

Overall, the GPS supervision program was estimated to cost approximately $3 million. As one might expect, the program is labor intensive ($2.4 million a year), but the second largest ingredient category was "other inputs," the lion's share of which is the cost of the GPS technology ($440,000). Based on an average number of parolees (400) in a given year, the yearly cost per parolee is $7,737 ($3,094,971/400), which translates into $21.20 per parolee per day. The GPS equipment alone costs about $2.95 per parolee per day†. The comparative daily cost of traditional supervision per parolee per day is $7.20. Consequently, in pure financial terms, the GPS supervision program costs roughly $14 per parole per day more than traditional supervision. Both of these figures, incidentally, are much less substantial than the cost of prison. While calculating the cost of prison is outside the scope of this study, the California Legislative Analyst's Office (LAO 2007) concluded that in 2008–09, it cost an average of about $47,000 per prisoner per year to incarcerate an inmate in California, which translates to about $129 per day.

Step 3. Combining Costs and Effectiveness

Once estimates of costs and effectiveness‡ are obtained, they can be combined to calculate a cost effectiveness ratio (CER) to help analyze the cost of each alternative. Computation of the CER is the cost of a given alternative (C) divided by its effectiveness (E):

$$CER=(C/E)$$

The ratio can be interpreted as the cost required to obtain a single unit of effectiveness. However, when a program is evaluated against current practice (as in this case), this computation must be augmented to account for the baseline, which is the alternative program. The ratio that evaluates an intervention against its baseline option (e.g., no program or current practice) is known as an incremental cost effectiveness ratio (ICER). ICER is defined as the ratio of the change in costs of an intervention (compared with the alternative, such as doing nothing or current practice) to the change in effects of the intervention. Computation of the ICER is similar, in that it is calculated by dividing the net cost of the intervention by the net outcome:

$$ICER=(C_1-C_2/E_1-E_2)$$

For example, as discussed above, the cost of the GPS program is $21.20 per day per parolee, while the cost of traditional supervision is $7.20 per day per parolee—a daily difference of $14. In addition, the GPS monitoring program demonstrated a 9 percentage–point reduction (from 56.1 percent to 46.7 percent) in arrests. In other words, the GPS monitoring program is more expensive, but more effective in reducing arrests. These findings (see table 3.10) translate into an ICER of -1.49. In other words, when compared with traditional parole supervision, GPS monitoring costs $1.49 per day per offender more than traditional parole to obtain a 1 percent ***decrease*** in arrests. Conversely, due to the positive effect of GPS monitoring on technical and nontechnical violations, the GPS program costs $10.77 per day per offender

* There were only three main differences in the costs of the two alternatives. These are 1) the GPS equipment, 2) the management contract with the GPS vendors, and 3) the GPS training of PAs.

† The cost of the GPS monitoring equipment is calculated at $2.95 per offender per day. Other included services are provided at no additional charge.

‡ Effectiveness estimates were obtained from the outcome analyses in the previous section.

Table 3.10. Incremental Cost-Effectiveness Ratio			
MEASURE	GPS	CONTROL	ICER
Technical Parole Violation[a]	43.9%	42.6%	**10.77**
Nontechnical Parole Violation[a]	54.9%	53.8%	**12.73**
Any Arrest[b]	46.7%	56.1%	**-1.49**
Violent Arrest[b]	12.5%	19.6%	**-0.32**

[a]This measure demonstrated a significant effect (see table 3.7).
[c]This measure demonstrated a significant effect (see table 3.8).

to obtain a 1 percent ***increase*** in technical violations and $12.73 per day per offender to obtain a 1 percent increase in nontechnical violations.

To interpret these seemingly contradictory ICERs properly, one must first recognize the purpose of the GPS program. On one hand, some jurisdictions may use GPS technology to monitor offenders with the goal of placing them back in custody for a parole violation (in lieu of an arrest and associated court proceedings). Other jurisdictions may view the goal of the program as reducing the recidivism of HRGOs by deterring criminal behavior through increased supervision. In California, the evidence suggests that GPS is used to accomplish the former—monitoring offenders closely with the intent of placing them back in custody through a violation of parole. Given this goal, the increase in parole violations can be interpreted as a positive finding that supports the objectives of the program.

To decide whether the GPS monitoring program offers "good" value for the money, the ICER must be compared with a specified monetary threshold. This threshold represents the maximum amount policymakers are willing to pay for effects on compliance or, in this case, noncompliance (maximum acceptable ceiling ratio). The intervention is deemed cost effective if the ICER falls below this threshold; otherwise, it is deemed not cost effective. For example, if a decision maker is willing to pay $100 per parolee per day for a 1 percent decrease in recidivism, the intervention is considered cost effective if the ICER is below $100. In this case, the GPS intervention would be considered cost effective if the threshold is set at around $14 to increase parole violations. This decision, however, is outside the scope of this study.

4. Process Evaluation

A. Overview

We conducted a process evaluation to provide a comprehensive understanding of the program context and determine whether the program was delivered as designed. More specifically, the process evaluation was designed to a) assess whether GPS program services were delivered as planned* and b) identify any gaps between program design and delivery.

In general, there are five components examined when considering fidelity (Dane and Schneider 1998):

1. *Adherence* (or integrity) refers to whether the program service or intervention is being delivered as it was designed or written (i.e., delivered to the appropriate population; by appropriately trained staff; using the right protocols, techniques, and materials; and in the locations or contexts prescribed).
2. *Exposure* (or dosage) refers to the measured quantity of a program. It may include the number of sessions implemented, the length of each session, or the frequency with which program techniques were implemented.
3. *Quality of program delivery* is the manner in which a teacher, volunteer, or staff member delivers a program (e.g., skill in using the techniques or methods prescribed by the program, enthusiasm, preparedness, or attitude).
4. *Participant responsiveness* is the extent to which participants are engaged by and involved in the activities and content of the program.
5. *Program differentiation* identifies the unique features of different components or programs that are reliably differentiated from one another.

This study concentrates on *adherence, exposure, quality of program delivery,* and *program differentiation* as the means for assessing overall fidelity. Though participant responsiveness may be an important function of program fidelity, it was outside the scope of this study.

B. Data Sources

We used two sources to collect data for the process evaluation: 1) a California Department of Corrections and Rehabilitation (CDCR) parole agent (PA) survey and 2) GPS monitoring data.

GPS Parole Agent Survey

The main source of data for the process evaluation was the PA survey†. The survey instrument was developed to collect process data from CDCR PAs. To facilitate comparisons between the two studies, it was adapted from the survey instrument used in the study of the CDCR GPS monitoring program for sex offenders (Gies et al. 2012). The final version contained questions in seven areas:

* The GPS program protocols were altered in September 2012 in response to the experiences of PAs in the field. Thus, it was problematic to assess implementation of each of the components as they changed over the course of the study. As a practical matter, this study measured program fidelity based on the protocols in place at the time of the survey.

† The issue of providing socially desirable responses (SDR) is inherent in all survey data. In this report, we attempted to minimize SDR in a number of ways. First, all survey questions were worded without judgment. Second, we adopted forced-choice questions where the options have been equated for their desirability. Third, the survey was administered through the Web, as the use of a computer, compared to the most competent interviewer, provides a higher sense of neutrality. Finally, we offered the assurance of confidentiality to all respondents.

Table 4.1. GPS Parole Agent Survey Responses by District			
Region	District	N	Percent
Region 1	**Fresno County**	**2**	**8**
Region 1	**Sacramento County**	**4**	**17**
Region 1	San Joaquin County	1	4
Region 2	Alameda County	1	4
Region 2	Santa Clara County	2	8
Region 2	Ventura County	1	4
Region 3	**Los Angeles City**	**2**	**8**
Region 3	**Los Angeles County**	**5**	**21**
Region 4	**Riverside County**	**3**	**13**
Region 4	**San Bernardino County**	**2**	**8**
Region 4	San Diego County	1	4
Total		24	99

Note: Totals do not equal 100 percent because of rounding. Original specialized gang units in **bold.**

1. Program staffing
2. Agent information
3. Equipment issues
4. Caseload specifications
5. Enrollment and orientation
6. Collaborative engagement
7. General summary

The instrument was emailed to all PAs in August 2012. PAs were sent numerous requests to complete the survey during the month. The survey was closed at the end of September 2012. The survey request received 24 unique and eligible responses. This figure roughly corresponds to the number of agents carrying gang-related GPS caseloads at the time of the survey. At the time of the survey, there were roughly 30 level 1 GPS PAs* with existing gang offender caseloads, yielding a good response rate (83.3 percent) for GPS PAs.

CDCR originally implemented six specialized gang units in the City of Los Angeles and the following California counties: Fresno, Los Angeles, Riverside, Sacramento, and San Bernardino. Subsequently, during the course of this study, CDCR first added (due to the high number of gang offenders under supervision) then withdrew (due to budget concerns) several specialized gang units.† Overall, the survey provided a good representation of the GPS PAs (see table 4.1). An analysis of the survey data by district suggests the volume of responses favored the regions‡ encompassing the original six specialized units, with Region 1 representing 29 percent of respondents, Region 2 representing 16 percent of respondents, Region 3 representing 29 percent of respondents, and Region 4 representing 25 percent of respondents. Notably, Region 3 (Los Angeles County) is the smallest geographic unit. The distribution across the original six districts was comprehensive, with at least two responses (most have many more) from each parole district.

* Level 1 PAs directly supervise parolees.

† The sample in his study is restricted to the original six specialized gang units.

‡ CDCR is organizationally and operationally divided into four distinct regions, with numerous districts within each region and numerous parole units within each district. Region 1 consists of the Central Valley, ranging from Bakersfield to the Oregon border, while Region 2 encompasses the coastal counties from Ventura to the Oregon border. Region 3 includes only Los Angeles County, and Region 4 consists of the southern counties of Imperial, Orange, Riverside, San Bernardino, and San Diego.

GPS Monitoring Data

The GPS monitoring data were used to categorize subjects in groups as well as for descriptive purposes and to assess the California GPS program model. The GPS monitoring system into which gang parolees are enrolled is operated by two vendors: Satellite Tracking of People (STOP) LLC and Pro Tech. STOP is used in the southern portion of California (Regions 3 and 4); Pro Tech was responsible for the northern areas (Regions 1 and 2).* Although the terminology of the vendors differs, the capabilities of hardware and software are virtually identical. As described in chapter 1, each vendor employs an active monitoring system that combines cellular and GPS technology to automatically track the location of a parolee. Each vendor provided the following data: a profile of the offender; a record of each GPS event† (Inclusion Zone, Exclusion Zone, Battery, Strap/Device, Cell Communication Gap, and No GPS Communication) that included the event start and stop times and duration during a specified period; and the assignment history of the device.

C. Program Fidelity

Adherence

According to the interim CDCR policy and procedures manual, there are four core components of the GPS program:

1. Program staffing qualifications
2. Caseload specifications
3. Parolee orientation specifications
4. Parole supervision specifications: GPS monitoring‡ and field contacts

Questions regarding each of these components were included in the GPS agent survey (see attachment B for survey questions). While many of the questions had multiple response categories, each question in reference to a core program component was recoded into a dichotomous response (1=response met the program requirement; 0=response did not meet program requirement). For instance, to assess the GPS training component, the agents were asked, "Approximately how many hours of GPS training have you completed?" The question was open ended and agents were asked to record a numeric response. The CDCR program protocol indicates that *all* high-risk gang offender (HRGO) PAs are required to attend 24 hours of GPS training. Responses of 24 hours or above were coded as meeting the requirement, while all other responses were coded as not meeting the requirement. These dichotomous measures of fidelity were then aggregated at the district level and divided by the number of valid responses to generate a percentage of adherence for each core component. The following sections detail and assess adherence to each program component.

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* It should be noted that CDCR recently discontinued its relationship with 3M and placed all parolees under the Satellite Tracking of People (STOP) LLC system.

† Although 3M provided a file designated to include event data, the majority of this data was missing. Efforts are ongoing to retrieve this data from 3M.

‡ GPS monitoring has always included the capability of zone creation. Originally, however, its use was discretionary; thus, there was significant variation in how PAs used the function. Consequently, the creation and operationalization of three zones for each GPS parolee were added as core program components subsequent to the development and execution of the GPS survey. Nevertheless, this component was not included as a measure of fidelity, for it was not active at the time of the study.

GPS PROGRAM STAFFING QUALIFICATIONS. The GPS supervision program staffing protocol restricts eligible personnel to those with the following qualifications:

- A PA assigned a specialized gang caseload MUST be trained by Electronic Monitoring Unit (EMU) staff.
- A PA assigned a specialized gang caseload MUST complete the specialized GPS training prior to supervising GPS monitoring parolees*.

The staffing qualification component was assessed through two items on the agent survey. Table 4.2 displays the results of the survey questions regarding the background of GPS agents. The survey reveals that the mean age of PAs was 42.3 years. The vast majority of PAs are male (96 percent) and have a 4-year college degree (46 percent). Unlike agents in the high-risk sex offender program (Gies et al. 2012), almost all (92 percent) agents volunteered for a GPS caseload. As one would expect with a relatively new program, few agents had a great deal of experience as GPS agents. In addition, the data suggest this type of *technology-driven* program attracts a younger, less experienced agent. Overall, the average length of service for GPS agents with a specialized gang unit was 8 years. On average, agents had a little more than 1½ years' experience with a gang offender caseload and just less than 3 years' experience with a GPS caseload. Overall, the data suggest that GPS agents with a gang offender caseload were around 42 years old with a 4-year college degree, but with less experience as an agent compared with all agents.

In terms of fidelity, all agents who responded indicated that they attended the GPS training provided by CDCR, but only 92 percent indicated they completed 24 hours of training. These findings indicate the fidelity to the program staffing qualifications component was relatively high (0.97), suggesting 97 percent

Table 4.2. GPS Parole Agent Qualifications

Sex	N	Percent
Male	23	95.8
Female	1	4.2
Missing		
Level of Education	**N**	**Percent**
Some college	7	29.2
Two-year college degree	4	16.7
Four-year college degree	11	45.8
Graduate degree	2	8.3
Missing		
Selection for GPS Unit	**N**	**Percent**
Voluntary	22	91.7
Compulsory	2	8.3
Not applicable		
Don't know		
Age	**N**	**Mean (in years)**
Age	24	42.13
Experience	**N**	**Mean (in years)**
How long as a parole agent (years)?	24	8.21
Time with GPS caseload (years)?	24	2.92
Time with a gang offender caseload (years)?	24	1.88

* At the time this study was being conducted, the agents received between 24–32 hours of training depending on the vendor. CDCR currently offers a 4-day training program divided between the vendor (24 hours) and CDCR (8 hours).

of the program component was implemented according to protocol. Moreover, there was minimal variation across districts (scores ranged from 0.75 to 1.00, SD 0.08). The relative standard deviation* is 8.2 percent, indicating relatively little dispersion across districts. The results in terms of fidelity by district are reported in table 4.4.

CASELOAD SPECIFICATIONS. Conventional wisdom suggests having small caseloads provides agents with more time to dedicate to supervision efforts and better overall recidivism rates (Burrell 2006). Consequently, the GPS supervision protocol restricted caseloads in the following manner:

- A specialized gang caseload will NOT exceed 20 cases.
- A specialized gang caseload will include ONLY active GPS cases.
- A specialized gang caseload will include ONLY GPS–monitored parolees.
- A specialized gang caseload will include ONLY gang offender parolees.
- A specialized gang caseload will include ONLY parolees who meet at least one of the mandatory criteria listed in the GPS Monitoring Gang Eligibility Assessment Criteria Form.

The caseload restriction component was assessed through five items on the agent survey. The first requirement of this component is that caseloads for the agents must not exceed 20 active cases. Table 4.3 indicates that overall, agents reported a maximum caseload size on any given day in the last month of 23 cases. The second requirement is that specialized gang caseloads comprise only active cases.† Contrary to the requirement, however, about one fourth of the agents indicated they had a mixed rather than active caseload. A comparison of the average caseload size by caseload type reveals a divergence in the maximum caseload size by type. Agents with *only* active caseloads reported a maximum caseload size of 21 cases, which is much more in line with the program specifications of 20 cases; agents with mixed caseloads reported a maximum of 27 cases. Moreover, the "active only" figure corresponds well with the monthly caseload size reports provided by CDCR, where the average caseload size over the 4-year period (2009–12) was 18.28 (SD=3.20) cases per agent. The third requirement is that GPS agents supervise only GPS–monitored parolees. The table indicates that this is true for all agents (100 percent).

Table 4.3. Caseload Specifications

Caseload Size	N	Mean
All	22	23.0
Active	16	20.9
Mixed	6	26.8
Only GPS Parolees	**N**	**Percent**
Yes	24	100
No	0	0
Only Gang Offenders	**N**	**Percent**
Yes	18	78.3
No	5	21.7
Gang Eligibility Assessment Criteria	**N**	
100 percent	16	69.6
Less than 100 percent	7	30.4

* The relative standard deviation (also referred to as the coefficient of variation) is a normalized measure of dispersion. The higher the number, the greater the dispersion in the variable.

† A mixed caseload is an agent with both active and passive cases. Active cases require the agent to review tracks daily. Passive cases require agents to review tracks a minimum of 2 days each month. All HRGOs are classified as active cases.

Conversely, however, despite the requirement that a specialized gang caseload will include ONLY gang offender parolees, only 78 percent of agents indicated their caseload solely comprised gang offender parolees. Finally, about two thirds (67 percent) of the agents indicated that only parolees who met at least one of the mandatory criteria listed in the GPS Monitoring Gang Eligibility Assessment Criteria Form made up their caseload. Interestingly, almost half (48 percent) of the agents reported an unfavorable attitude regarding the ability of the form to properly identify offenders who are appropriate for the specialized caseload.

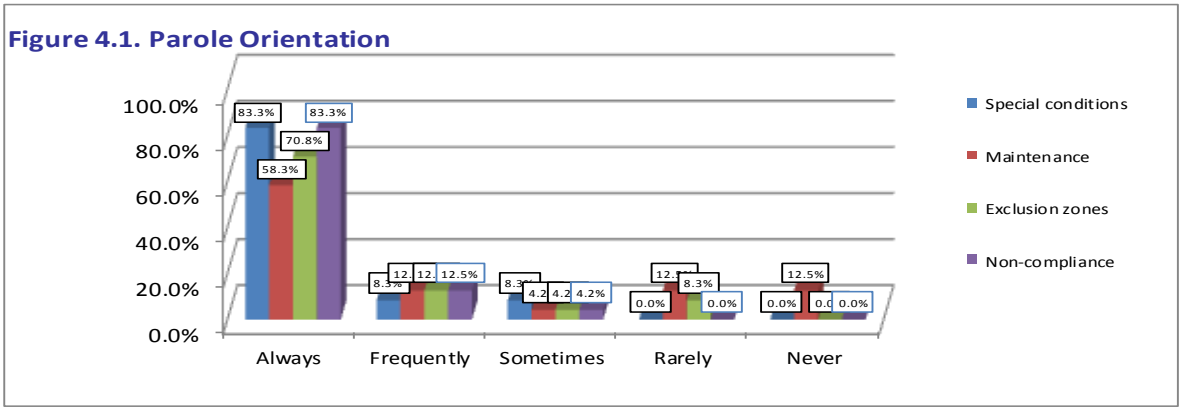
In terms of fidelity to the program protocol, these findings suggest the caseload component displayed a fair degree of fidelity (0.76), but with quite a bit of variation across districts, as the scores ranged from 0.60 to 1.00 (SD=0.14). The relative standard deviation is 18.4 percent, confirming the relatively high dispersion (compared with 8.4 in staff requirements) across districts. The results in terms of fidelity by district are reported in table 4.4.

GPS ORIENTATION. PAs are required by statute to present general information to parolees on the laws and policies regarding parole release (i.e., conditions of parole, supervision practices, revocation policies, and any other information the board deems relevant). The GPS program protocol specifies that

- A PA assigned a specialized gang caseload MUST advise the parolee that GPS supervision is a special condition of parole.
- A PA assigned a specialized gang caseload MUST familiarize the parolee with the maintenance of the GPS monitoring system.
- A PA assigned a specialized gang caseload MUST describe to the parolee specific behaviors that constitute noncompliance.
- A PA assigned a specialized gang caseload SHOULD (when appropriate) effectively describe to the parolee prohibited areas (i.e., exclusion zones*) in writing.

The orientation component was assessed through four items on the agent survey. Figure 4.1 indicates the vast majority of agents report that they always or frequently (90 percent or more) explain 1) GPS supervision is a condition of parole and 2) the consequence for noncompliance, and to a lesser extent, the parolee prohibited area (82 percent). Interestingly, however, only about 70.8 percent of the agents always or frequently discuss the care and maintenance of the device. This lower figure regarding care and

Figure 4.1. Parole Orientation



* To maintain public safety, GPS parole agents may not describe each zone restriction in explicit detail. For example, agents will inform a parolee that he or she is to have no contact with the victim and place an exclusion zone around the residence of the victim, but the agent will not disclose the address of the victim and thus the exact location of the exclusion zone.

maintenance may be a result of parolees becoming so familiar with the device that agents don't feel the need to explain these details during the orientation period. In any event, these results translate into a high overall fidelity score (0.88) with minimal variability across districts (scores ranged from 0.71 to 1.00; SD=0.12). The relative standard deviation of 13.6 percent confirms the relatively low dispersion (compared with 8.4 in staff requirements) across districts. The results in terms of fidelity by district are reported in table 4.4.

PAROLE SUPERVISION SPECIFICATIONS. Though early advocates of EM believed this tool could increase the manageable caseload under supervision, experience with the technology has suggested the opposite. This workload increase stems from multiple factors, such as the need 1) for officers to monitor GPS equipment, to respond to alerts (many of which can be "false" alerts [Elzinga and Nijboer 2006]), 2) to teach offenders how the equipment works, and 3) to ensure the equipment is maintained and replaced when it fails. In addition, there are many well-documented limitations of this technology. As noted in chapter 1, GPS receivers require an unobstructed view of the sky and often do not perform well because of interference from buildings, terrain, electronics, or sometimes even dense foliage. These obstructions can cause position errors or possibly no position reading at all (see chapter 1 for more detail on limitations). Finally, although GPS units may be able to track where offenders are, they cannot provide information on what they are doing. Consequently, the use of GPS is considered a tool of the gang offender supervision program. It is not designed to replace traditional parole supervision but rather to augment it with additional information otherwise unavailable to the agent. To integrate these two approaches, the GPS program protocol details specific GPS and field contact responsibilities for the agents. The responsibilities for each category are as follows in parts A and B below:

Part A. GPS

- A PA assigned a specialized gang caseload MUST review the Daily Summary Report (DSR) for each GPS–monitored parolee at regular intervals.*
- A PA assigned a specialized gang caseload MUST conduct a track review for each GPS–monitored parolee at regular intervals using specific methods.
- A PA assigned a specialized gang caseload MUST immediately respond to all GPS alert† notifications as specified by the CDCR protocol.
- A PA assigned a specialized gang caseload MUST resolve all GPS alert notifications and note actions taken to clear the event. (exclusion, inclusion, tamper, gap, cell, battery)
- A PA assigned a specialized gang caseload MUST assign a residence inclusion zone (or transient inclusion zone for homeless parolees), a travel restriction zone, and a victim exclusion zone (if applicable). (residence, travel, victim)

* The exact number is known to the researchers. However, at the request of CDCR and to preserve the integrity of the parole program, this figure is omitted from the final report.

† The Vendor Monitoring Center (VMC) assists PAs in monitoring GPS alerts. The VMC follows pre-established protocols to triage GPS alert information. For less urgent alerts, the VMC attempts to resolve the alert directly prior to PA involvement. In the event the alert cannot be resolved as well as for more urgent alerts, the VMC notifies the PA via text message and/or telephone.

Part B. Field contact supervision

- A PA assigned a specialized gang caseload MUST establish first contact with the parolee within a specific number* of days after release.
- A PA assigned a specialized gang caseload MUST conduct the initial interview within a specific number* of days after release.
- A PA assigned a specialized gang caseload MUST meet at the parolee's residence within a specific number* of days after release.
- A PA assigned a specialized gang caseload MUST conduct a minimum number* of face-to-face contacts with the parolee each month.
- A PA assigned a specialized gang caseload MUST conduct a minimum number* of collateral contacts per month.
- A PA assigned a specialized gang caseload MUST meet with law enforcement to update parole information a minimum number of times* per year.
- A PA assigned a specialized gang caseload MUST conduct a minimum number* of random drug tests each month.
- A supervisor MUST conduct a case conference review a minimum number* of times each year.

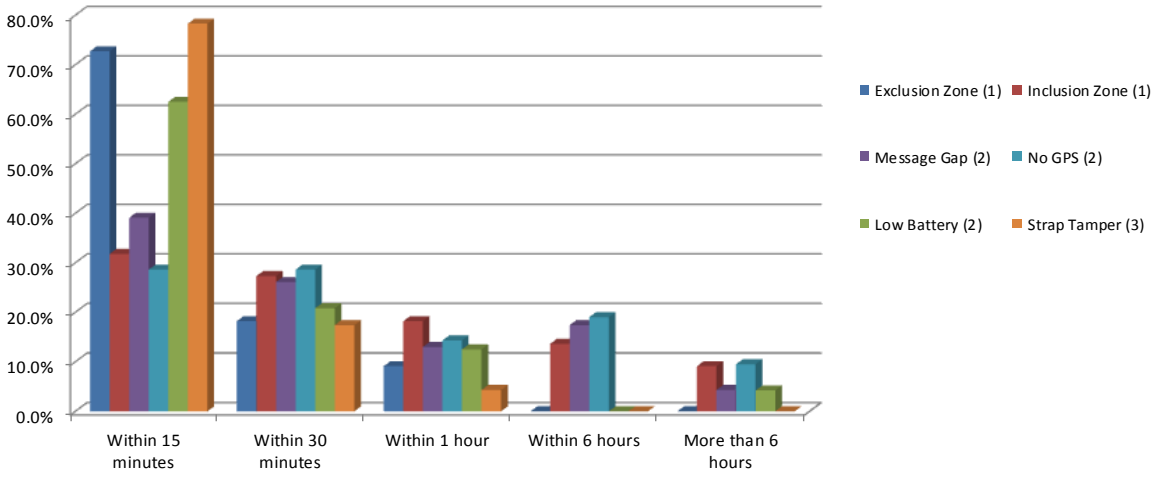
The use of GPS monitoring (part A) of the integrated supervision program component was assessed through five items in the agent survey. The first requirement of this component is that the PAs must review the DSR for each offender on their caseload at regular intervals. Despite this requirement, only 74 percent of PAs who responded reported that they review the DSR as often as prescribed. This lack to diligence to the DSR requirement is likely explained by the finding that only 36 percent of PAs reported the DSR was "quite useful" in supervising parolees. In fact, each of the nine PAs who found the report "quite a bit helpful" also reviewed the report as prescribed (χ^2=27.68, p<.001).

The second requirement of this component is that PAs must review the tracks for each offender on their caseload at regular intervals. Unlike the DSR requirement, almost all agents (96 percent) reported reviewing tracks as prescribed in the protocol. Similarly, almost all agents (92 percent) indicated that reviewing tracks was quite useful in their job-related duties.

The third requirement is that PAs must respond to all GPS alert notifications. Figure 4.2 indicates how quickly PAs reported that they responded to various alerts. A number of PAs reported they responded to each alert type within 15 minutes. However, the responses varied by event. Almost all agents (91 percent) reported they responded to exclusion zone alerts and strap tampers (96 percent) within 30 minutes. A majority of agents also reported that they responded quickly to low battery (83 percent) alerts, but this percentage decreases significantly for inclusion (59 percent), message gap (65 percent), and no GPS (57 percent) alerts.

* The exact number is known to the researchers. However, at the request of CDCR and to preserve the integrity of the parole program, this figure is omitted from the final report.

Figure 4.2. Responding to GPS Alerts



The reason for this decline is likely due to the nature of the alert. For instance, many inclusion zone alerts are purely for informational purposes, where agents can monitor the movements of a subject but do not require immediate action. Moreover, message gap and no GPS alerts are often the result of parolee mobility. For example, a message gap occurs when the device has been unable to make a successful call to the GPS system for several consecutive hours. Such a situation may occur if the offender is in a remote location with no cell service. The topography of the area, specifically hills, ridges, mountains or other land features, can also block signals. A no GPS alert on the other hand occurs after the device has been unable to receive a GPS signal for several consecutive hours. As noted in chapter 1, GPS receivers require an unobstructed view of the sky. Interference from buildings, terrain, electronics, or sometimes even dense foliage can cause the loss of a GPS signal. As an acknowledgement of these factors, agents justifiably do not respond hastily to these types of alerts, especially if cell or GPS reception is a recognized and common problem in a particular area.

The fourth requirement is that the PAs must resolve all GPS alert notifications and note actions to clear the event. Again, a number of PAs report they always note actions to clear an event, but the numbers fall short of the requirement. The number of agents who reported they always or frequently note events varied by the type of alert: exclusion alert (83 percent); inclusion alert (73 percent); strap tamper (91 percent); message gap (79 percent); no GPS (63 percent); and low battery (83 percent).

The final requirement is that PAs must assign a residence inclusion zone (or transient inclusion zone for homeless parolees), a travel restriction zone, and a victim exclusion zone (if applicable). For this requirement, the vast majority of agents report they always or frequently assign the prescribed zone restrictions. The number of agents who reported they always or frequently assign each zone varied by the type of zone: residence (92 percent); travel restriction (96 percent); and victim (87 percent). Not surprisingly, given the discretion on the part of the agent, the victim zone requirement is the type of zone restriction least often implemented.

These results translate into a good fidelity score (0.82), suggesting that 82 percent of the program

components were implemented according to protocol, with relatively little variability across districts (range of 0.59 to .94; SD=0.10). The relative standard deviation of 13.4 percent confirms the relatively high dispersion (compared to 8.4 in staff requirements) across districts. The results in terms of fidelity by district appear in table 4.4.

The use of traditional parole supervision (part B) was assessed through eight items from the agent survey and corroborated by accessing the record of supervision data. PA responses indicated that 96 percent of PAs reported they generally meet face to face with the parolees on the first working day after release; 100 percent reported they meet at the parolee's residence within 7 working days of release; 91 percent reported they typically conduct the initial interview within 1 day of release; 86 percent of PAs reported the unit supervisor holds a case review at least twice a year; 91 percent reported they typically meet with law enforcement to update parole information at least twice a year; and 100 percent indicated they conduct a drug test at least once a month. Similarly, no agent indicated that on average he or she has fewer than two face-to-face contacts or two collateral contacts per month.

Table 4.4. GPS Program Fidelity by District

Region	District	N	Staff	Caseload	Orientation	Monitor	Supervision
Region 2	Alameda County	1	1.00	.75	1.00	.94	1.00
Region 1	Fresno County	2	.75	.60	.75	.59	.87
Region 3	Los Angeles City	2	1.00	.60	.88	.82	.69
Region 3	Los Angeles County	5	.90	.68	.70	.88	.89
Region 4	Riverside County	3	1.00	.67	1.00	.80	1.00
Region 1	Sacramento County	4	1.00	.85	.88	.79	1.00
Region 4	San Bernardino County	2	1.00	.78	1.00	.81	.92
Region 4	San Diego County	1	1.00	1.00	.75	.88	1.00
Region 1	San Joaquin County	1	1.00	.75	1.00	.94	1.00
Region 2	Santa Clara County	2	1.00	.70	.75	.69	1.00
Region 2	Ventura County	1	1.00	1.00	1.00	.88	.

Note: An empty cell indicates that there were not enough responses to calculate a score.

These results translate into a relatively high fidelity score of 0.94, suggesting 94 percent of the program component was implemented according to protocol. Moreover, there was minimal variation across districts (scores ranged from 0.69 to 1.00, SD=0.10). The relative standard deviation is 10.9 percent, confirming the relatively little dispersion across districts. The results in terms of fidelity by district are reported in table 4.4.

Exposure

Exposure (or dosage) refers to the measured quantity of a program. It may include any of the following: the number of program sessions implemented, the length of each session, or the frequency with which program techniques were implemented. In this study, exposure refers to the amount of time under GPS supervision. It was assessed through the GPS monitoring data.

Parolees placed on a specialized gang caseload are required to be supervised with GPS technology continuously during a period of parole. However, unlike sex offenders in California, there is no requirement that a suspected gang member be placed on the specialized gang caseload. In other words, CDCR officials have the discretion to use GPS monitoring with any offender released onto parole who is eligible under the Gang Eligibility Assessment Criteria. Thus, in terms of fidelity, exposure is not applicable

in this study. Nevertheless, table 4.5 provides the details regarding exposure to GPS monitoring. The subjects in this study were observed for 2 years. During the course of the observation period, 350 treatment subjects were placed on GPS monitoring. These 350 subjects spent an average of 204 days over 2 years on GPS monitoring with a range spanning 727 days.* The average number of assignments per subject was about three (M=2.90; SD=2.00). The average time per assignment was about 70 days (M=70.61; SD=75.65).

Table 4.5. Parolee Exposure to GPS Monitoring

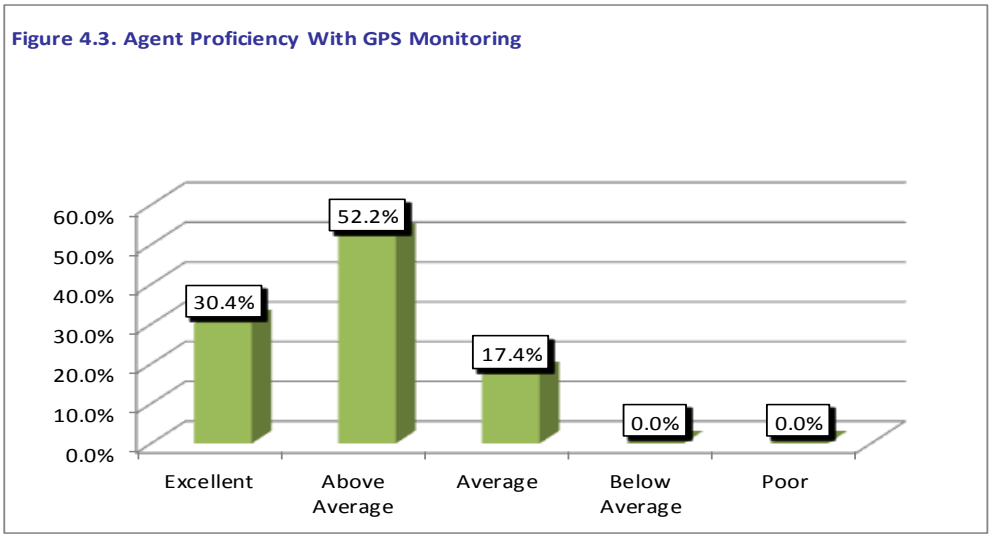
Type of Exposure	N	Mean	SD
Number of GPS assignments (per subject)	350	2.90	2.00
Days on GPS (per subject)	350	204.55	172.16
Days on GPS (per assignment)	1014	70.61	75.65

Note: The GPS tracking data revealed 42 offenders (10.7 percent) assigned to the treatment group, while exposed to GPS monitoring during the parole period, did not receive GPS monitoring during the two-year tracking period following the current release from custody event. In addition, CDCR placed 21 (5.4 percent) of the control group offenders on GPS monitoring subsequent to the group assignment for the study. This analysis focused on the 350 subjects in the treatment group who were exposed to GPS monitoring during the study period.

Quality of Program Delivery

Quality of Program Delivery is the manner in which a teacher, volunteer, or staff member delivers a program (e.g., skill in using the techniques or methods prescribed by the program, enthusiasm, preparedness, or attitude). The quality of program delivery was assessed through the agent survey data. Figure 4.3 provides the results of a self-assessment through the survey of agent proficiency with the GPS

Figure 4.3. Agent Proficiency With GPS Monitoring

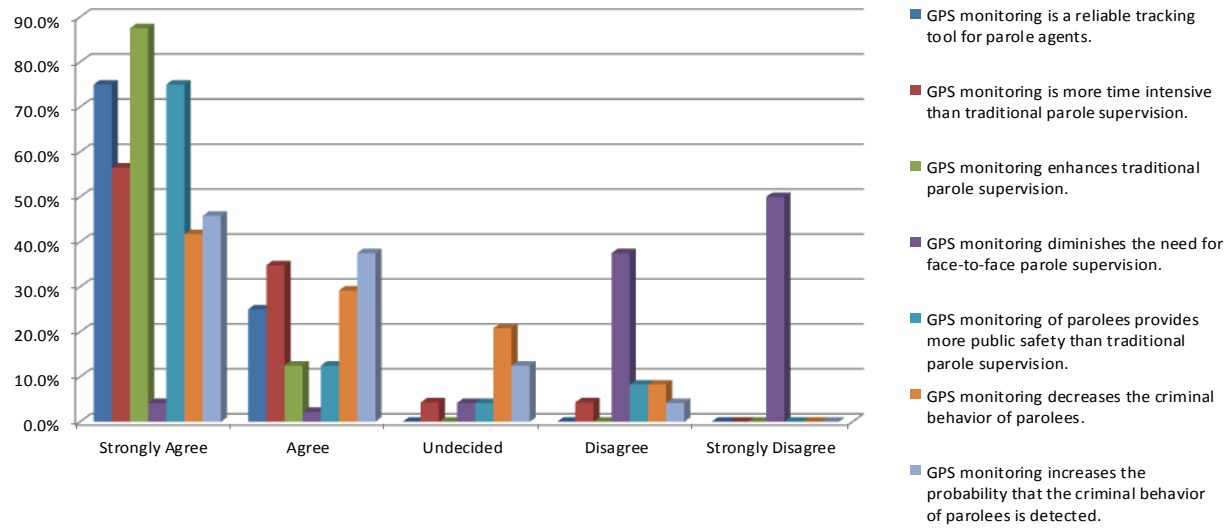


monitoring system to gauge the skill of the agent in using techniques prescribed by the program. The data indicate that more than 83 percent of agents polled considered themselves excellent or above average with the system. In addition, figure 4.4 reports the assessment of the degree to which agents had a positive attitude toward the GPS supervision program. The data indicate overwhelmingly positive support for the use of GPS technology as a monitoring tool. Specifically, 100 percent of agents who responded agreed or strongly agreed that the GPS monitoring system is a reliable tracking tool and felt GPS enhanced traditional parole supervision. Moreover, 87 percent felt GPS supervision provided more public safety than traditional parole supervision.

* One subject was placed on and removed from GPS the same day for a total of 0 days on GPS monitoring.

Interestingly, this positive attitude toward GPS supervision was found in lieu of the majority of agents (91 percent) reporting that GPS monitoring is more time intensive than traditional supervision. Overall, these findings suggest that in terms of quality of delivery, the GPS program was delivered with proficient skill and a positive attitude.

Figure 4.4. Feelings Regarding the GPS Monitoring System



Program Differentiation

Program Differentiation identifies the unique features of different components or programs that are reliably differentiated from one another. As noted above, there are five core program components of the GPS program. However, individuals in the control groups were subject to the same program components as treatment group subjects, save one: GPS monitoring. The single difference between traditional parole supervision and GPS parole supervision is the use of GPS technology as a monitoring tool. Consequently, traditional parole supervision should be differentiated from GPS parole supervision by the absence of GPS monitoring. We use GPS monitoring data to assess program differentiation. Table 4.6 indicates the majority of subjects in the GPS supervision group (89.3 percent) received GPS monitoring during the two-

Table 4.6. Program Differentiation Between GPS and Traditional Supervision

	Control			GPS			
	N	Mean	SD	N	Mean	SD	T–Value
GPS Supervision (in period)[a]	392	.05	.23	392	.89	.31	-43.38***
GPS Supervision (ever)[b]	392	.08	.27	392	1.00	.00	-67.48***

Note: Sample size: GPS group= 392; control group=392. [a]GPS assignment during the tracking period. [b]GPS assignment ever.

* p<.05. ** p<.01. *** p<.001

year tracking period. In comparison, 5.4 percent of the subjects selected for the control group received GPS monitoring. At first blush, the fact that some treatment group subjects did not receive GPS monitoring and some control group subjects did suggests the possibility of contamination, as one may

expect the two groups to be diametrically dissimilar in terms of GPS supervision. However, a broader examination of the GPS data indicates that all (100 percent) of the subjects in the GPS monitoring group were placed on a specialized gang caseload and received GPS monitoring at some point during the parole period (either before or after the study tracking period). Conversely, it should not be a surprise that some subjects, selected a priori for the control group, were subsequently placed on GPS monitoring, as the program structure is designed to be fluid in order to serve the changing needs of CDCR. In other words, with a finite number of GPS units available, agents may remove a unit from one offender and place it on another at any point in time depending on makeup of the pool of offenders on parole who meet the eligibility requirements. Accordingly, CDCR placed 21 subjects (5.4 percent) from the control group on GPS monitoring subsequent to group assignment for the study because real-life circumstances necessitated the monitoring. Nevertheless, the significant difference between the groups shows the GPS program is visibly differentiated from traditional parole supervision ($t=43.38$, $p<.001$).

D. GPS Monitoring

GPS Events

As indicated in chapter 1, there are various different alerts recorded by the monitoring center, and subsequent notifications transmitted to the supervising PA through a text message or phone call. A low-battery event indicates the battery must be charged. A strap/device event denotes a tamper with the strap or receiver itself. An inclusion event indicates a breach of an inclusion zone parameter. The most common inclusion zone is a curfew within the parolee's residence at night. An exclusion event points to the presence of the parolee within an excluded space, such as known areas of gang activity and residences of other gang members/associates. A cell communication gap indicates an interruption in the communication signal between the cell towers and the device. Finally, a no-GPS-communication event indicates a problem in the communication signal between the satellite system and device. It should be noted that while the start and stop times of each of these events are recorded by the monitoring center, the event in and of itself may not be considered a violation depending on the rules governing the event.* For instance, a cell communication gap can last several hours before it becomes a genuine violation. Table 4.7 displays the prevalence, frequency, and duration of each event type.

Prevalence refers to the proportion of a population found to have the condition. In this case, it refers to the proportion of the population that experienced each unique GPS event. All subjects generated at least one GPS event. The most prevalent event type recorded by the monitoring center was a strap/device

Table 4.7. Prevalence and Duration of GPS Events

	Parolees	Number of Events /Parolee		Duration of Events[a]	
GPS Event Type	Percent	Mean	SD	Mean (in minutes)	SD
Inclusion	60.5	45.11	88.73	139.20	352.73
Exclusion	14.2	5.09	31.80	21.54	138.42
Battery	70.1	23.20	58.37	125.40	572.75
Strap/Device	85.4	29.07	66.54	4.08	4973.14
Cell Communication Gap	71.5	5.32	15.80	804.36	1735.54
No GPS Communication	84.3	8.78	19.36	836.67	78444.02
Any Event	100.0	116.58	155.80	142.76	21816.12

Note: GPS event data for the study period were available from a single vendor (i.e., STOP). The second vendor (i.e., 3M, was unable to provide the data at the date of publication (N=281). [a]The mean durations reported here are 5 percent trimmed to exclude the most extreme values.

* The rules governing each event type are known by the author but withheld here at the request of CDCR.

event, generated at least once by 85 percent of the subjects. The diffuse nature of this type of event suggests the possibility that most parolees at some point either maliciously tampered with the device or do not follow proper maintenance instructions as detailed in their special conditions of parole. Another potential explanation is that many of the events were caused by hardware problems. The reality, however, may be that all three explanations contributed to the pervasive nature of the events. Furthermore, given the high percentage of parolees who experienced a low battery event (70 percent), it is possible that these types of events were due to a lack of compliance with the required maintenance of the GPS device rather than purposeful attempts to damage the device. Similarly, potential technological limitations may be the source of other common alerts such as no GPS communication (84 percent) and cell communication gap (72 percent). As noted in chapter 1, GPS receivers require an unobstructed view of the sky and often do not perform well due to interference from buildings or other topographical obstructions. These obstructions can cause the signal to degrade and generate alerts to the reporting center without any malevolent intent on the part of the parolee. Conversely, an exclusion zone was the least common type of event, experienced by only 14.2 percent of parolees. Unfortunately, there are no data available to interpret whether the cause of these events was the consequence of parolee behavior, an equipment malfunction, or another innocuous origin.

Frequency, on the other hand, is the number of occurrences of a repeating event per unit. Table 4.7 presents the average number of GPS events per parolee. The mean number of GPS events per parolee is 117 with a median of 57 events. Interestingly, while not the most prevalent, the most frequent event type (45 events per parolee) is an inclusion zone. Conversely, some of the most prevalent GPS events did not occur with great frequency. For example, 84 percent of parolees generated a no-GPS-communication alert, but with only about nine events per parolee. Similarly, 72 percent of parolees generated a cell communication gap alert, but with only about five events per parolee. Finally, some GPS events were both prevalent and frequent. Strap tampers, for instance, were generated by 85 percent of parolees with each parolee responsible for about 29 strap-related events. Likewise, low-battery events were generated by 70 percent of parolees, with each parolee responsible for about 23 low-battery events.

Finally, the mean length of all events was just less than 143 minutes (or less than 2.5 hours). A strap/device event offered the shortest mean duration, lasting about 4 minutes. Conversely, no-GPS-communication events offered the longest mean duration, lasting approximately 836 minutes or just under 14 hours. A cell communication gap event also demonstrated on average a long period of time (approximately 804 minutes or just under 13.5 hours). Although at first glance one might be alarmed at the length of these events, the results are not surprising, given the rules permit a lost GPS signal or cell communication gap of several consecutive hours before even generating an alert. Moreover, the fact that these alert types are also the most prevalent support the notion that these alerts are the result of topographical obstructions that recurrently but not expectantly cause communication errors, thus generating alerts.

E. Summary

This process evaluation was designed to determine whether the program was delivered as designed and to provide an understanding of the program context. This chapter concentrated on *adherence, exposure, quality of program delivery,* and *program differentiation* as the means for assessing overall fidelity. On the whole, the GPS program demonstrated a high degree of fidelity across each dimension. A summary of each dimension is provided below:

Adherence refers to whether the program service or intervention is being delivered as it was designed. In this case, the program was composed of five core components: program staffing requirements, caseload restrictions, HRGO parolee screening, parolee enrollment and orientation specifications, and parole supervision specifications. The findings demonstrate that while there was some variation across districts, overall program fidelity was high* in terms of adherence to program staffing requirements (0.97), caseload specifications (0.76), parolee orientation (0.88), GPS supervision (.82), and field supervision (0.94).

Exposure refers to the measured quantity of a program. The GPS tracking data suggests subjects under GPS supervision spend an average of about 100 days per year on GPS monitoring. The average number of unit assignments per subject was about three (M=2.90; SD=2.00) and the average time per assignment was about 70 days (M=70.61; SD=75.65). However, unlike the California GPS program for sex offenders, where each subject is required to be continuously monitored by GPS (i.e., 365 days), there is no prescribed GPS dosage level for offenders in the gang program, resulting in a wide variation in the number of days offenders are placed under GPS supervision (GPS supervision days ranged from 0† to 727). Consequently, dosage, while relevant for understanding the operation of the program, is not applicable as a measure of fidelity in this study.

Quality of program delivery is the manner in which a teacher, volunteer, or staff member delivers a program (e.g., skill in using the techniques or methods prescribed by the program, enthusiasm, preparedness, or attitude). The findings indicate that more than 83 percent of agents polled considered themselves excellent or above average with the system. In addition, the data indicate overwhelmingly positive support for the use of GPS technology as a monitoring tool. Overall, these findings suggest that in terms of quality of delivery, the GPS program was delivered with proficient skill and a positive attitude.

Program differentiation identifies the unique features of different components or programs that are reliably differentiated from one another. The single difference between traditional parole supervision and GPS supervision is the use of GPS technology as a monitoring tool. The findings indicate that all of the subjects in the GPS monitoring group were placed on a specialized gang caseload and received GPS monitoring at some point during the parole period. Conversely, a small number of subjects (5.4 percent) from the control group were placed on GPS monitoring subsequent to group assignment because CDCR determined there was a tangible need to do so. Nevertheless, the significant difference between the groups shows the GPS program is visibly differentiated from traditional parole supervision.

Finally, an analysis of the *GPS monitoring* data found the most prevalent event type was a strap/device event. In fact, strap tampers and low-battery events were both prevalent and occurred with great frequency among parolees. However, the most prevalent events were not necessarily the most frequent. For example, no-GPS-communication alerts and cell communication gap alerts were both very prevalent, but occurred irregularly. Unfortunately, there are no data available at this time to interpret whether the cause of these events was the consequence of parolee behavior, a technological limitation, equipment malfunction, or another innocent origin.

**High* equals above 75 percent. *Average* is 50 percent to 74 percent. *Poor* is less than 50 percent.
† One subject was placed on and removed from GPS on the same day.

5. Discussion and Recommendations

A. Summary

Only a few previous studies have rigorously examined the effectiveness of global positioning system (GPS) monitoring, but none have explored its effects on gang members. The results of this study suggest GPS monitoring integrated into a traditional parole supervision regime is associated with decreased odds of arrests, but with increased odds of parole violations compared with traditional parole supervision. Moreover, there is some preliminary evidence that subjects in the GPS group are significantly more likely to return to custody than control group subjects. Overall, in comparison to some recent studies regarding effectiveness of GPS in reducing recidivism of other populations (i.e., sex offenders), this study provides evidence that GPS is an effective suppression tool for removing individual gang members from the community.

The GPS and control groups were well matched in this study after the use of propensity score adjustments for numerous pretreatment characteristics. At baseline, mean scores on a wide range of demographic and pretreatment characteristics are remarkably similar between the groups. Despite these baseline similarities, a curious pattern of divergence in outcomes emerges during the two-year study period. The odds of a technical violation are 36 percent greater among the GPS group, while the odds of a nontechnical violation are 20 percent greater. Conversely, the GPS group is less likely to be rearrested in general (the chance of being rearrested is 26 percent lower) and for violent crimes (32 percent lower).

At first glance, these findings appear contradictory. However, an interpretation through the lens of a suppression program framework offers clarity. Suppression programs often use a combination of policing, prosecution, and incarceration to remove individual gang members from the community (Howell 2000). The goal of these programs is to influence gang member behavior by dramatically increasing certainty, severity, and swiftness of criminal justice sanctions (Braga and Kennedy 2002). The use of GPS technology to monitor high-risk gang offenders (HRGOs) falls within this context. In fact, one of the most common gang suppression programs involves the operation of special gang probation and parole caseloads with high levels of surveillance and more stringent revocation rules for gang members (Klein 2004). The program described in this study offers many of the same features but overlays GPS monitoring as an added level of surveillance.

With this in mind, data suggest the California Department of Corrections and Rehabilitation (CDCR) may utilize GPS as a suppression program in which the technology is used to monitor offenders with the goal of placing them back into custody for injudiciousness. Specifically, during the time of this study, CDCR may have used parole violations (in lieu of an arrest for a new offense) and a parole board (in lieu of traditional court proceedings) as the means for placing GPS–monitored gang members back into custody (given prison overcrowding in California, this practice may have been curtailed). Criminologists have coined the term "back-end sentencing" to describe this practice (Grattet et al. 2008).

Back-end sentencing can be a powerful practice when used with GPS technology, given the wealth of information delivered quickly by GPS. The expansive nature of GPS data in conjunction with strict revocation rules offers a higher probability of detecting a parole violation than a new crime. Moreover, intervening when a subject violates parole, but before the commission of a new and possibly violent crime, aligns with the CDCR directive of protecting the public. *As a result, given the goal of removing high-*

risk offenders from the streets, the increased odds of GPS subjects being discovered for committing a parole violation is interpreted as a positive finding that supports the objectives of the program.

It is also important to note the increased odds of parole violations are not inconsistent with the decreased odds of arrest if one considers the temporal sequence of events. If offenders are released from prison, placed on GPS, and monitored diligently until committing a parole violation, it stands to reason they are less likely to have opportunities to engage in criminal behavior for which they would be arrested. Conversely, agents cannot as readily detect parole violations of non-GPS–monitored parolees. In these cases, agents must often wait for parolees to commit a new offense for which they can be charged.

Although this practice suggests improved public safety with the return of HRGOs to prison through parole violations rather than through commission of a new crime, there are less benign implications for public safety as well. That is, while the burden of evidence is lower, there is some evidence that addressing new criminal acts through parole proceedings rather than through the criminal justice system results in a less severe sentence. For example, Grattet and colleagues (2008) showed parolees who were returned to prison by the parole board for homicide served an average of 9.9 months, whereas those convicted of homicide in criminal courts served 91 months. Similarly, parole violators who returned to prison for robbery served 9.6 months versus 53 months when convicted in criminal court of robbery. Parolees who returned to prison for alleged rape and sexual assaults served 8.6 months versus 45 months when convicted in a criminal court. Although this study did not include data on length of sentences upon return to prison for the treatment and control groups, such practices are clearly a dimension of interest to programs considering GPS monitoring.

This study also provides cost details for the GPS monitoring program in comparison with the cost of traditional supervision. The analysis found the cost of the GPS program is $21.20 per day per parolee, while the cost of traditional supervision is $7.20 per day per parolee—a difference of about $14*. However, the results favored the GPS group in terms of the program's goal: removing dangerous gang members from the community. In other words, the GPS monitoring program is more expensive, but may be more effective. Specifically, when compared with traditional parole supervision, GPS monitoring costs $1.49 per day per offender more than traditional parole to obtain a 1 percent ***decrease*** in arrests. Conversely, due to the positive effect of GPS monitoring on technical and nontechnical violations, the GPS program costs $10.77 per day per offender to obtain a 1 percent ***increase*** in technical violations and $12.73 per day per offender to obtain a 1 percent ***increase*** in nontechnical violations.

Finally, this study also provides evidence regarding the degree to which program services were delivered as designed. The results show CDCR developed a protocol for the program and, for the most part, followed that protocol while implementing the program. Overall the process evaluation reveals the GPS program was implemented with a high degree of fidelity across the four dimensions examined: *adherence*, *exposure, quality of program delivery,* and *program differentiation*.

* It should be noted that both options are less costly than incarceration. The California Legislative Analyst's Office (2007) concluded that in 2008–09 it cost an average of about $47,000 per prisoner per year to incarcerate an inmate in California. This translates into about $129 per day.

B. Policy Implications

Gang members are engaged in a large array of violent crimes. According to a recent analysis conducted by the National Gang Intelligence Center, gang members are responsible for 90 percent of all violent crime in jurisdictions with a large concentration of gang members, like California (NGTA 2011). Moreover, despite the overall dramatic declines in violent crime nationally, Howell and colleagues (2011) found overwhelming evidence that gang violence rates have continued in California and throughout the country at exceptional levels over the past decade (Howell et al. 2011).

Consequently, the response of criminal justice agencies to gang activity in California and other states and jurisdictions throughout the United States is a vital public safety concern. As indicated earlier, these responses can generally be grouped into three broad categories: prevention, intervention, and suppression. Suppression programs are by and large considered the least effective gang program type (Decker 2002), but relatively few gang programs, regardless of strategy type, have been found to reduce the criminal behavior of gang members (Klein and Maxson 2006, Howell 1998, Spergel 1995), and little serious evaluation research has concentrated specifically on gang suppression strategies (Klein 1995). This research helps fill the gap. Moreover it provides evidence that suppression programs designed to keep high-risk offenders off the street may offer benefits by decreasing community violence and increasing public safety. However, the cost analysis suggests the GPS monitoring program is more expensive. Specifically, it costs about $14 per offender per day more than traditional supervision. Is the increase in public safety worth the cost? While policymakers will ultimately be faced with the harsh decision of how much they are willing to pay for a safer community, there are a number of policy recommendations borne from the observations and findings of this study that could improve the effectiveness and/or reduce the costs of the program, making it more cost effective and thus more attractive to policymakers. These recommendations (some of which overlap with the recommendations proposed in Gies et al. 2012) are presented below.

Not All Gang Offenders Are Created Equal

The GPS program for gang offenders differs from the program for sex offenders in two important ways. First, not all gang offenders are required to be placed on GPS monitoring. Second, gang offenders are not categorized as high risk or non-high risk through the use of a standardized risk assessment tool. Instead, to be eligible for placement on the specialized gang offender caseload, a parolee must meet at least one of the mandatory criteria listed in CDCR Form 2203 (Rev. 0411 0), GPS Monitoring Gang Eligibility Assessment Criteria, prior to assignment (see chapter 1 for the list of criteria). If the parolee meets any of these criteria, the parole agent (PA) holds a case conference with the Unit Supervisor to determine if placement on the caseload is appropriate. The obvious problem with this assignment method is that the subjectivity of this decision-making process may not accurately account for natural variation in the risk of recidivism among gang offenders. In turn, this subjectivity can lead to bias in the selection process and ultimately result in offenders being inappropriately placed on GPS monitoring.

Given the apparent goal of the program is to place dangerously *violent gang offenders* back into custody, it can be assumed the most appropriate offender is an identified gang member with a high propensity toward violence. As a result, we recommend the adoption of a more formalized decision process that ensures the targeted population is being served by the program. Specifically, we ***recommend incorporating a risk instrument designed to predict violent offending into the existing decision-making process.*** For example, GPS Monitoring Gang Eligibility Assessment Criteria could remain the standard criteria for gang member identification, but a risk instrument could be incorporated to empirically account

for the differential risk of recidivism and thus assist CDCR in determining which gang members are the most suitable for GPS monitoring. For this purpose, some of the most common instruments include the Historical, Clinical, Risk Management-20 (HCR-20), the Violence Risk Appraisal Guide (VRAG), and the Structured Assessment of Violence Risk in Youth (SAVRY). Another possibility would be to employ an instrument specifically developed for and already in use in California. Known as the California Static Risk Assessment (CSRA) tool, the CSRA is an actuarial instrument that uses static information on offenders to make a statistical prediction regarding recidivism. Modeled after the Washington State Department of Corrections Risk Assessment tool, it categorizes each offender into one of five groups (i.e., low, moderate, high drug, high property, and high violent) and predicts recidivism along three different scales (violent, property, and any felony). While there was some variability across measures, analyses of the predictive validity of the instrument revealed it to be moderately accurate for most of the three types of predicted recidivism (Turner et al. 2009).

This is not to say, however, that gang offenders who pose a relatively lower risk of violent recidivism should go unsupervised. Rather, it indicates that—when faced with the challenges of a great number of gang offenders in the community and limited resources—governmental agencies will be best served by reserving GPS monitoring for those who pose the greatest risk of reoffending.

Going Beyond Crime Mapping

Although CDCR currently has the capacity to use its GPS monitoring program to run crime correlations, the use of GPS monitoring holds the potential for unprecedented insight into gang-related activity. By its very nature, GPS technology allows for an exceptional gain in the geographic intelligence of gang member activity by specifically tracking mobility and engagements of a parolee. We recommend ***moving beyond traditional crime scene correlations to combine geospatial mapping and social network analysis in order to identify the contacts, ties, and attachments one gang has to another.***

Traditional criminal intelligence, as gathered in CompStat-like crime analytic tools, relies upon reports of crimes being adequately mapped to a geographic space to inform police response. Social network analysis, on the other hand, examines social relationships in terms of network theory, consisting of nodes (generally representing individual actors within the network) and ties (which generally represent relationships between the individuals, such as friendship, kinship, etc.). It provides a useful theoretically grounded backdrop to the exploration of micro-level social interaction and relations among gang members (Roman et al. 2012). The application of social network analysis to GPS monitoring data of gang offenders goes beyond a simple overlay of crimes with offender location data to provide unprecedented intelligence on actual movements, day-to-day activities, and relationship structures of local gangs. It may even provide insight into interrelationships among members of rival gangs with contiguous territories. This information can be useful to law enforcement officials to 1) expand their knowledge of relationships, behaviors, and structures within gang organizations, 2) gain improved understanding of existing and changing territorial range, and 3) provide opportunities to identify and remove key organizational leaders in order to disrupt gang-related activities. Sharing this information by establishing memoranda of understanding with local law enforcement, especially in Los Angeles, could lead to greater certainty and accuracy in proactive policing of gang-controlled neighborhoods, as well as improved safety for the communities in which these offenders are paroled.

Conduct a Cost Analysis on Outsourcing the Monitoring Center Function

Because GPS supervision of parolees can generate an overwhelming amount of information, creating a

monitoring center function is crucial for the smooth operation of GPS programs. For instance, in an analysis of the GPS program for sex offenders in California, parolees under GPS supervision generated 1.5 million alert notifications from January 2009 to December 2010 (Thompson 2011). However, only a small portion of these alerts required a real response. This in turn has forced PAs to spend more time looking at computer screens than in the field. According to an internal CDCR document, this level of verification caused PAs to spend 44 percent of their time monitoring parolee movements by GPS and only 12 percent of their time in the field (Thompson 2011).

In response to this issue, CDCR initiated a Vendor Monitoring Center (VMC) in October 2012 for both sex and gang offenders placed on GPS supervision, to triage events in real time. The VMC follows preestablished protocols to triage GPS event information. For less urgent events, the VMC will attempt to resolve issues directly with the parolee prior to PA involvement. If the VMC cannot resolve the event with the parolee, it is escalated to the PA. For more urgent GPS alerts, the VMC provides immediate notification to the PA in accordance with established notification protocols.

We support this modification to alleviate the demand on agents of responding to "technical alerts" so they may focus more closely on direct supervision and responding to alerts that pose real threats to community safety. In fact, several large states with a considerable number of GPS–monitored offenders—including Texas, Florida, and Michigan—use monitoring centers to screen GPS–generated events. Moreover, Bales and colleagues (2010) found that a statewide monitoring center was one of the most dramatic improvements to the Florida Department of Corrections' electronic monitoring program. The strategy resulted in dramatic reductions in the number of minor alerts officers must address, which enables them to devote more time to matters directly related to supervision of offenders in the community. The report goes on to recommend that electronic monitoring programs nationwide "should consider including this strategy in their operation" (Bales et al. 2010, p. xiii).

However, it should be noted there are numerous ways to configure a monitoring center, some of which may be more or less costly for CDCR. The main difference separating the various methods is who receives and reviews the alerts and the associated alert flow processes. There are three basic options for receiving alerts (Brown, McCabe, and Wellford 2007):

- *Option 1. Vendor operates monitoring center.* In this scenario, the vendor's service representatives review and analyze each event and contact applicable agency personnel in the event of a legitimate violation. Additionally, the vendor software may send automatic alerts by pager to specified agency personnel for resolution.

- *Option 2. Third party operates monitoring center.* In this scenario, a third-party company conducts the event review and analysis and contacts applicable agency personnel as appropriate. When the third party receives the event for review and analysis, the agency personnel may also be contacted simultaneously by pager.

- *Option 3. Internal monitoring center.* In this scenario, the monitoring center is internal to the agency and not accessible to a third party. Also in this situation, agency personnel may be contacted by pager at the same time the monitoring center is contacted.

In addition, some agencies use a hybrid of options 1 and 3 by having agency personnel receive alerts

directly from the software during regular duty hours (option 1) and using an in-house monitoring center (option 3) during off-duty hours.

Considering the volume of offenders on GPS monitoring in California and the cost associated with outsourcing the operation of the monitoring center, ***we further recommend that CDCR conduct a study to determine the marginal cost of internalizing the monitoring center.*** As noted in the cost analysis presented in chapter 3, the contract with the vendor to provide this and other GPS–related services is the second largest program expenditure. It may be more cost effective to internalize this function within CDCR by equipping and training CDCR staff to operate the monitoring center rather than outsourcing the task to a vendor. Although outsourcing is generally considered an effective strategy to reduce or contain costs, this is not always the case. Moreover, most analysts discourage organizations from outsourcing core functions that directly affect the products or services the organization offers (Biggs 2000), and it can be argued that GPS monitoring is a core function of the CDCR GPS Monitoring Unit.

Push Criminal Prosecution

While back-end sentencing is not without merit (e.g., swiftly removing potentially violent criminals from the community), the practice used in California permits some dangerous offenders to dodge more severe penalties that may have been imposed had the cases been prosecuted in the criminal court system (as opposed to being handled by the parole board). ***We recommend that, whenever possible, parolees who commit new crimes, particularly crimes of a serious nature, be prosecuted to the fullest extent of the law in criminal courts.***

Continue to Emphasize the Use of GPS Monitoring as a Tool

The final recommendation has been offered elsewhere (Gies et al. 2012), but it bears repeating here. Public officials should ***bear in mind that GPS monitoring is merely a useful tool in the larger context of parole practice. It is not a panacea for all things criminal.*** This recommendation is borne from the inflated expectations of GPS monitoring attributable to misconceptions about what GPS monitoring can actually accomplish (Payne and DeMichele 2011). While California recognizes this concept and integrates this principle into its training, its importance cannot be overstated.

Parole departments have many tools available for parolee supervision. Unlike most of these tools, however, the utility of GPS is often overstated. In truth, GPS can fail. GPS receivers require an unobstructed view of the sky and often do not perform well because of interference from buildings, terrain, electronics, and even dense foliage. These obstructions can cause position errors or render no position reading at all. In addition, there have been documented cases of false negatives, where actual violations may not be detected by the system (Elzinga and Nijboer 2006) and instances of false positives, when offenders were recorded in one place but agents knew them to be elsewhere (Sachwald 2007). In addition, an overload of false positives or technical alerts can cause agent complacency, which may in turn result in a failure to act during real violations. Finally, GPS units may be able to track where offenders are, but they cannot always provide information on who the offender is with or what he or she is doing.

Nevertheless, these limitations do not make the technology ineffective. A hammer is a valuable tool for striking nails, forging metal, and breaking objects, but it is not particularly effective as a means of cutting through materials. Similarly, GPS technology as a supervision tool has value as a means of tracking and monitoring behavior of high-risk offenders. It is not designed to prevent offenders from ever committing a crime, nor is it particularly effective in doing so. An expectation such as this that goes beyond the design

of the tool is destined to fail and, perhaps more important, gloss over its benefits. This and other research shows GPS, whether used as a deterrent (as with a sex offender population) or as a means of suppression (as with a gang offender population) offers a level of increased supervision that is useful for monitoring dangerous and violent offenders who are released into the community.

Thoughtfully Grow the Program

Recent evidence suggests that GPS monitoring is a useful supervision tool. However, little research has investigated the use of GPS technology as a tool to deter criminal behavior by removing serious and violent offenders from the streets. While not conclusive, this study provides promising evidence that GPS technology offers increased public safety by potentially removing dangerous criminals from the streets before they commit more violent crimes. *It is recommended that CDCR carefully weigh the benefits and detriments of the program, but consider expanding the GPS monitoring of HRGO to additional units*. The main benefit appears to be the potential for increased public safety. The key detriment rests on the increased costs: not only the costs of operating the GPS program, but also the costs associated with returning these offenders to custody. Moreover, an expansion of the program would likely benefit from focusing on urban areas of California where gang-related crime and violence is most problematic. In such a setting, the effects of the program could be more pronounced in leading to a concentrated increase in public safety for violent neighborhoods. Such an expansion of the program would also serve as fertile ground to continue to research and explore the role of GPS in crime suppression, as well as the mechanisms at work which affect gang offenders' recidivism.

C. Limitations

Several limitations of this study should be noted. Foremost is the lack of a pure experimental design. Random assignment was not possible and it was necessary to construct a comparison group from historical controls (i.e., subjects who were observed at some time in the recent past and for whom data were available through records). Such a group could be subject to a history threat.

In addition, because we adopted a propensity score matching procedure rather than random assignment, the possibility exists that the comparison subjects differed in important and unobserved ways from GPS supervised subjects, and we cannot be certain any observed differences in outcomes are attributable to treatment rather than to systematic differences in the subjects. For instance, we would have liked to have controlled for variables such as education, propensity toward violence, and deviant peer associations, among others, but these types of data were not available. However, the two groups were similar in all measures included in the propensity score matching, and we included statistical controls for other factors including prior criminal histories, moves over time, and differences across districts.

Another limitation is related to the observed gaps in GPS tracking data. Parolees placed on a specialized gang caseload are required to be continuously supervised with GPS technology during their periods of parole. However, unlike sex offenders in California, there is no requirement that a suspected gang member be placed on the specialized gang caseload. In other words, CDCR officials have the discretion to use GPS monitoring with any offender released onto parole who is eligible under the Gang Eligibility Assessment Criteria. This discretion that permits parolees to go on and off GPS supervision at any time serves as the major source of gaps in GPS supervision. Other gaps resulted from the replacement of GPS–consumable equipment such as the strap or receiver, or by an arrest or other event that resulted in the offender being placed into custody, as the GPS receiver unit is removed during any custody event and replaced upon release. We should note, however, that this study took an intent to treat (ITT) approach to

account for offenders who were assigned to the treatment group but did not receive GPS monitoring during the two-year tracking period. In general, the ITT approach is a conservative estimate of the treatment effect, because an experimental subject may be arrested or violate their parole conditions while not actually on GPS but still assigned to the GPS condition.

A potential limitation of our research was the choice to use discrete-time models over continuous-time models, which by definition requires losing some information (e.g., moving from days at risk to month at risk). While this is a limitation, we feel the benefits outweigh the loss of information. First, we were able to observe the parolees for 2 years—longer than most GPS evaluation studies. Second, while continuous-time models can accommodate repeated events and time-varying covariates, the use of discrete-time models is a convenient and intuitively appealing approach for both of these issues. Finally, as we used dummy variables for each month of the study, we made no assumptions about the shape of the discrete-time hazard function, which can seriously affect the results (Rabe–Hesketh and Skrondal 2012).

Another potential limitation is the potential for selection bias as GPS agents may have more expertise, more experience, or are in some other way better agents than non-GPS agents and that this difference may influence the effects attributed to the program. Unfortunately, in order to address this potential bias, we would have had to either 1) randomly assign offenders to agents or 2) collect data on all CDCR agents and incorporate it into a model as a covariate. The former, as noted earlier, was not possible as it would have interfered with the program operations; the latter would have added considerable time and expense (i.e., surveying more agents) as well as complexity (i.e., most parolees changed agents at least once, with many changing quite often) to the study. Given the level of complexity and the limitations of the data (e.g., sample size, number of parole agent changes, etc.), it is unlikely that the effect of expertise on the outcomes could have satisfactorily been resolved. Moreover, there is little evidence that traditional parole supervision, whether expert or otherwise, is an important variable as it relates to recidivism. In fact, a study by the Urban Institute found parole supervision has little effect on rearrest rates of released prisoners. Specifically, the study found mandatory parolees fared no better on supervision than similar prisoners released without supervision (Solomon, Kachnowski, and Bhati 2005).

A final limitation common to most research in this area is that the data used in the analyses were collected through official arrest statistics collected by the State of California. The primary weakness of arrest data is that they are collected only for criminal events that come to the attention of the police and result in an arrest (Hawkins et al. 2000). Crimes that do not gain this attention go undocumented, resulting in a clear underreporting of crime. In addition, changes in organizational activities or policy can have an effect on official data, which should not be mistaken for changes in criminal behavior. As long as the evaluator is aware of the potential pitfalls of these data and represents them in the report, official records are a valuable source of evaluation data. Moreover, we believe the finding of a negative effect of GPS on arrests, controlling for being at risk of an arrest, points to the robustness of the findings, given the GPS group was more highly supervised than the control group.

D. Next Steps

The results of this study suggest some further investigation. While research (Petersilia 2003, Langan and Levin 2002) demonstrates the first year after release accounts for nearly two thirds of all subjects who recidivate in the first 3 years, a final third will recidivate in the following 2 years. It would be intriguing to extend the study period an additional year to account for these events in the analysis.

In addition, preliminary evidence on the greater number of GPS–monitored offenders returning to custody suggests that the increased ability to detect and investigate crimes and parole violations using GPS tracking technology aids CDCR in reducing violence and increasing public safety by removing these offenders from the streets. This particular aspect of the program (i.e., the use of GPS technology as an investigative tool), as well as a discrete-time survival analysis of the return-to-custody-finding, will be the subject of a forthcoming follow-up report.

Another avenue of research is the enhancement of criminological theory. In fact, there are at least two theoretical perspectives that might be informed by GPS tracking data. The first, rational choice theory (e.g., Clarke and Cornish 2001), provides a foundation for other theories and suggests that criminals use reason when considering when and where they will or will not commit a crime. This leads some to believe that criminals use "hunting patterns" when they are considering committing a crime. GPS tracking data could be used to map those patterns (both time and location) prior to a crime to assess whether the patterns fit a rational choice interaction between the offender and their environment. For example, rational choice theory provides the principle of least effort. In contrast to much public opinion, and what Felson (2002) refers to as the "the ingenuity fallacy" (which is to overstate the skill required to commit a crime), rational choice theory suggests that offenders act on proximate targets not far from his or her home. A more complex formal model has been suggested that there is a distance decay function (DDF) with crimes being less likely to occur the further an offender moves away from his or her home. The model has been elaborated on to suggest that there are sometimes "buffer zones" where offenders will not want to commit an offense "too close" to his or her home. GPS tracking could certainly be used to inform rational choice theories of this type (Rossmo and Rombouts 2008).

Routine activity theory, a related but distinct form of rational choice theory, might also be informed by the GPS tracking of parolees. The theory basically states that crime can only occur with the presence of 1) a motivated offender, which could be almost anyone but certainly a HRGO, 2) a suitable target, which could be a property, an innocent victim, or another gang member, and 3) the absence of a capable guardian. Originally the theory was developed to explain macro social changes that changed people's "routine activities" away from the home (e.g., women entering the work force, the availability of cars) leading to motivated offenders finding suitable targets without the presence of a capable guardian (Cohen and Felson 1979). Since, the theory has since morphed in several directions including more individual-level hypotheses and analyses. The GPS tracking provides information on both location and time. We can document when and where an offense occurred and link that information with other geographic information about the potential targets (people or things) that were available at the time and what sorts of guardians were and were not there. Even if the offender cuts the strap and goes off to offend, where and when then strap was cut can be compared with where and when the offense occurred by linking this theory with the DDF typically unassociated with routine activity theory. Surely there are other avenues for GPS tracking data to inform criminological theory.

It should be noted however, that the data provided here focus solely on gang parolees who know they are being monitored, and presumably know where and when they are supposed to be as well as where they are not supposed to be. Consequently, while the results may not be generalizable to offenders in general, much can still be learned from those who know they are being monitored.

A third avenue for research may be to assess the predictive power of GPS events. In other words, is there a discernible pattern among GPS events that precede violent or criminal behavior? For instance, is there

an association between preceding inclusion zone events and subsequent criminal behavior? Perhaps three or four events within a specified time period would provide an indication of an impending criminal incident. Another possible pattern may be that the interval between events becomes shorter and shorter as an impending criminal incident approaches. If these or any other predictive pattern exists among GPS events, and agents could be trained to identify or be alerted to the existence, such knowledge would prove invaluable to agents who monitor daily activities of offenders, and in some cases even make the difference between life and death.

Finally, given the divergent findings of the sex offender and gang GPS programs, it may be of interest to test the application of GPS monitoring with other types of offenders. Such offenders include drunk drivers, spousal abusers, those with substance abuse problems, and those with mental disorders. In addition, GPS monitoring can and has been used as a pretrial supervision alternative to jail, and as an alternative to incarceration for selected offenders. In pretrial situations, many of these same offender types would warrant GPS. However, this is often done to provide assurance of the offender's return to court using the least restrictive means of supervision consistent with victim and public safety, not as an approach to reintegrate the offender into the community. Similarly, GPS supervision may be used in conjunction with probation as an alternative to a prison or jail term. In any event, the research on these topics is sparse and warrants further investigation.

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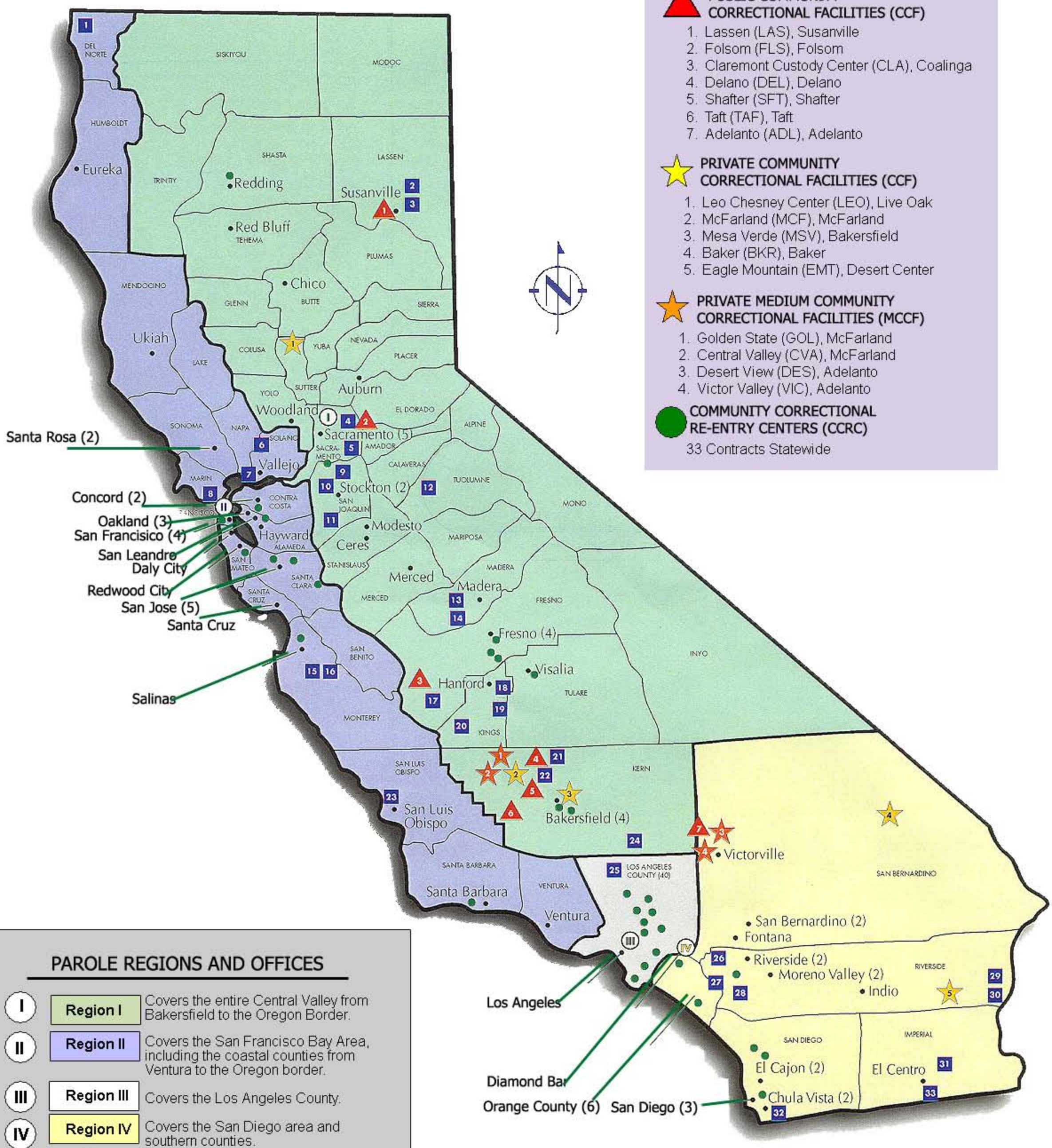
ATTACHMENTS

ATTACHMENT A.
CALIFORNIA DEPARTMENT OF CORRECTIONS AND REHABILITATION MAP

DIVISION OF ADULT PAROLE OPERATIONS



ATTACHMENT B.
PAROLE AGENT SURVEY

Evaluation of the GPS System for Monitoring Gang Offenders: CDCR

In May 2007, Gov. Arnold Schwarzenegger proposed an antigang initiative—known as the California Gang Reduction, Intervention, and Prevention (CalGRIP) program—to provide more than $48 million in state and federal funding for local antigang efforts. One of the provisions of this initiative was to expand the California Department of Corrections and Rehabilitation (CDCR) program of monitoring high-risk gang offenders on parole. Despite the increasing popularity of electronically based monitoring systems, little is known about their effectiveness in reducing the recidivism of gang members or their use as an investigative and prosecutorial tool. This study is designed to test the effectiveness of the GPS system in reducing recidivism and its use as an investigative and prosecutorial tool. It is being conducted by Development Services Group, Inc., with funding provided by the National Institute of Justice.

We request that you take this short survey to help us learn how you use the GPS technology to monitor the parolees under your supervision. Your participation in this study is completely voluntary. There is no penalty if you choose not to participate. We expect that the survey will take about 10 minutes. For the study to be of value, you must answer the questions honestly. Your answers will be kept confidential, and the information you provide will not be shared with anyone outside of the research team. It is important to understand that your performance is not being assessed.

***1. If you agree to participate, please click "I Accept." If you choose not to participate, please click "I Refuse."**

- ◯ I Accept
- ◯ I Refuse

Evaluation of the GPS System for Monitoring Gang Offenders: CDCR

Agent Information

*1. What area do you work in?

- ◯ Fresno County
- ◯ Los Angeles City
- ◯ Los Angeles County
- ◯ Riverside County
- ◯ Sacramento County
- ◯ San Bernardino County

*2. What is your current position with the California Department of Corrections and Rehabilitation (CDCR)?

- ◯ Parole Agent I
- ◯ Parole Agent II
- ◯ Parole Agent III
- ◯ Not Applicable

Other (please specify)

3. What year were you born?

Year (Example: 1969)

4. What is your gender?

- ◯ Male
- ◯ Female

5. What is the highest level of education you have completed?

- ◯ Less Than High School
- ◯ High School
- ◯ Some College
- ◯ Two-Year College Degree
- ◯ Four-Year College Degree
- ◯ Graduate Degree
- ◯ Do Not Know
- ◯ Not Applicable

6. How long (in years) have you been a parole agent (PA)?

Years (Ex: 5)

*7. Are you a GPS parole agent?

- ◯ No
- ◯ Yes
- ◯ Do Not Know
- ◯ Not Applicable

*8. Do you have gang offenders on your caseload?

- ◯ No
- ◯ Yes
- ◯ Do Not Know
- ◯ Not Applicable

*9. Are you a unit supervisor?

- ◯ No
- ◯ Yes
- ◯ Do Not Know
- ◯ Not Applicable

Agent Information (cont'd)

1. How would you describe the process for which you were selected to participate in the GPS program?

- ◯ Voluntary
- ◯ Compulsory
- ◯ Do Not Know
- ◯ Not Applicable

Other (please specify)

2. How long have you worked in the GPS unit?

Years (Ex: 1)

Months (Ex: 3)

3. How long have you had a gang caseload?

Years (Ex: 1)

Months (Ex: 3)

4. Is your current caseload active, passive, or mixed?

- ◯ Active
- ◯ Passive
- ◯ Mixed (Active and Passive)
- ◯ Do Not Know
- ◯ Not Applicable

GPS Equipment

1. Were you issued the following equipment to monitor the parolees under your supervision?

	No	Yes	Don't Know	NA
Laptop	◯	◯	◯	◯
Wireless Card	◯	◯	◯	◯
Tags/Straps	◯	◯	◯	◯
Installation Tools	◯	◯	◯	◯
Cell Phone	◯	◯	◯	◯
Handheld GPS Unit	◯	◯	◯	◯

Other (please specify)

2. In general, how often do you experience the following problems with the GPS equipment?

	Never (0% of cases)	Rarely (1% to 30% of cases)	Sometimes (31% to 60% of cases)	Frequently (61% to 99% of cases)	Always (100% of cases)	DK	NA
Internet Access	◯	◯	◯	◯	◯	◯	◯
Cellular Service Access	◯	◯	◯	◯	◯	◯	◯
Unit Failure	◯	◯	◯	◯	◯	◯	◯
False Strap Tamper Alert	◯	◯	◯	◯	◯	◯	◯
Unit Charging Malfunction	◯	◯	◯	◯	◯	◯	◯
Drift	◯	◯	◯	◯	◯	◯	◯

Other (please specify)

Caseload Specifications

1. How many parolees are currently under your direct supervision (you are the agent of record)?

Current Number (Ex: 10)

2. In the last month, what is the MAXIMUM number of parolees you have directly supervised?

Maximum Number (Ex: 15)

3. In the last month, what is the MINIMUM number of parolees you have directly supervised?

Minimum Number (Ex: 5)

4. Are all parolees whom you supervise gang offenders?

- ◯ No
- ◯ Yes
- ◯ Do Not Know
- ◯ Not Applicable

5. Are all parolees whom you supervise monitored with GPS technology?

- ◯ No
- ◯ Yes
- ◯ Do Not Know
- ◯ Not Applicable

6. About what percent of parolees whom you currently supervise meet at least one criteria of the Gang Eligibility Assessment Criteria?

Percent (Ex: 50)

7. Would you please rate how well you feel the Gang Eligibility Assessment Criteria identifies gang offenders?

- ◯ Poorly
- ◯ Below Average
- ◯ Average
- ◯ Above Average
- ◯ Excellent
- ◯ Do Not Know
- ◯ Not Applicable

Enrollment and Orientation

1. In general, how often do you discuss the following topics with parolees under your supervision during orientation?

	Never (0% of cases)	Rarely (1% to 30% of cases)	Sometimes (31% to 60% of cases)	Frequently (61% to 99% of cases)	Always (100% of cases)	DK	NA
GPS as a Special Condition of Parole	◯	◯	◯	◯	◯	◯	◯
Unit Charging	◯	◯	◯	◯	◯	◯	◯
Unit Components	◯	◯	◯	◯	◯	◯	◯
Inclusion Zone Restrictions	◯	◯	◯	◯	◯	◯	◯
Exclusion Zone Restrictions	◯	◯	◯	◯	◯	◯	◯
Behaviors That Constitute Noncompliance	◯	◯	◯	◯	◯	◯	◯

Other (please specify)

Monitoring Specifications

1. How often do you typically review the Daily Report of each parolee?

- ◯ At Least Once a Day
- ◯ Two or More Times a Week
- ◯ Once a Week
- ◯ One to Three Times a Month
- ◯ Never
- ◯ Do Not Know
- ◯ Not Applicable

2. To what extent do you find the Daily Report useful in performing job-related duties?

- ◯ Not at All
- ◯ Somewhat
- ◯ Quite a Bit
- ◯ Do Not Know
- ◯ Not Applicable

3. During normal working hours, about how quickly do you typically respond to the following alerts?

	Within 15 Minutes	Within 30 Minutes	Within 1 Hour	Within 6 Hours	More Than 6 Hours	DK	NA
Exclusion Zone Alert	◯	◯	◯	◯	◯	◯	◯
Inclusion Zone Alert	◯	◯	◯	◯	◯	◯	◯
Device/Strap Tamper Alert	◯	◯	◯	◯	◯	◯	◯
Message Gap Alert	◯	◯	◯	◯	◯	◯	◯
No Cell Coverage Alert	◯	◯	◯	◯	◯	◯	◯
Low Battery Alert	◯	◯	◯	◯	◯	◯	◯

4. How often do you note actions taken to resolve each alert in the vendor database?

	Never (0% of cases)	Rarely (1% to 30% of cases)	Sometimes (31% to 60% of cases)	Frequently (61% to 99% of cases)	Always (100% of cases)	DK	NA
Exclusion Zone Alert	◯	◯	◯	◯	◯	◯	◯
Inclusion Zone Alert	◯	◯	◯	◯	◯	◯	◯
Device/Strap Tamper Alert	◯	◯	◯	◯	◯	◯	◯
Message Gap Alert	◯	◯	◯	◯	◯	◯	◯
No Cell Coverage Alert	◯	◯	◯	◯	◯	◯	◯
Low Battery Alert	◯	◯	◯	◯	◯	◯	◯

5. To what extent do you find the alerts useful in the performance of your job-related duties?

- ◯ Not at All
- ◯ Somewhat
- ◯ Quite a Bit
- ◯ Do Not Know
- ◯ Not Applicable

6. How often do you typically review the tracks of each parolee?

- ◯ At Least Once a Day
- ◯ Two or More Times a Week
- ◯ Once a Week
- ◯ One to Three Times a Month
- ◯ Never
- ◯ Do Not Know
- ◯ Not Applicable

7. To what extent do you find the review of tracks useful in the performance of your job-related duties?

- ◯ Not at All
- ◯ Somewhat
- ◯ Quite a Bit
- ◯ Do Not Know
- ◯ Not Applicable

8. How often do you use the following inclusion/exclusion zones?

	Never (0% of cases)	Rarely (1% to 30% of cases)	Sometimes (31% to 60% of cases)	Frequently (61% to 99% of cases)	Always (100% of cases)	DK	NA
Inclusion: Residence of Parolee	◯	◯	◯	◯	◯	◯	◯
Inclusion: Travel Restriction	◯	◯	◯	◯	◯	◯	◯
Inclusion: Informational Only	◯	◯	◯	◯	◯	◯	◯
Exclusion: Another State	◯	◯	◯	◯	◯	◯	◯
Exclusion: Residence of Victim	◯	◯	◯	◯	◯	◯	◯
Exclusion: Informational Only	◯	◯	◯	◯	◯	◯	◯

9. To what extent do you find the use of inclusion zones useful in the performance of your job-related duties?

- ◯ Not at All
- ◯ Somewhat
- ◯ Quite a Bit
- ◯ Do Not Know
- ◯ Not Applicable

10. To what extent do you find the use of exclusion zones useful in the performance of your job-related duties?

- ◯ Not at All
- ◯ Somewhat
- ◯ Quite a Bit
- ◯ Do Not Know
- ◯ Not Applicable

Monitoring Specifications (cont'd)

1. On average, how many days after release does it typically take for you to meet face to face with a new parolee for the first time?

- ◯ 1 Day
- ◯ 2 Days
- ◯ 3 Days
- ◯ 4 or More Days
- ◯ Do Not Know
- ◯ Not Applicable

2. On average, how many days after release does it typically take for you to visit the parolee's residence for the first time?

- ◯ 1 Day
- ◯ 2 Days
- ◯ 3 Days
- ◯ 4 or More Days
- ◯ Do Not Know
- ◯ Not Applicable

3. On average, how many days after release does it typically take for you to complete the initial interview?

- ◯ 1 Day
- ◯ 2 Days
- ◯ 3 Days
- ◯ 4 or More Days
- ◯ Do Not Know
- ◯ Not Applicable

4. On average, how many days after release does it typically take for you to complete the comprehensive interview?

- ◯ 1 Day
- ◯ 2 Days
- ◯ 3 Days
- ◯ 4 or More Days
- ◯ Do Not Know
- ◯ Not Applicable

5. On average, how many times per month do you meet face to face with each parolee at the residence of record?

- ◯ Never
- ◯ 1 Time
- ◯ 2 Times
- ◯ 3 Times
- ◯ 4 or More Times
- ◯ Do Not Know
- ◯ Not Applicable

6. On average, how many collateral contacts (any communication with other people concerning a parolee) per month do you make associated with each parolee?

- ◯ Never
- ◯ 1 Time
- ◯ 2 Times
- ◯ 3 Times
- ◯ 4 or More Times
- ◯ Do Not Know
- ◯ Not Applicable

7. On average, how many times per year do you meet with law enforcement to update the parolee's information?

- ◯ Never
- ◯ 1 Time
- ◯ 2 Times
- ◯ 3 Times
- ◯ 4 or More Times
- ◯ Do Not Know
- ◯ Not Applicable

8. On average, how many times per month do you test the parolee for drugs?

- ◯ Never
- ◯ 1 Time
- ◯ 2 Times
- ◯ 3 Times
- ◯ 4 or More Time
- ◯ Do Not Know
- ◯ Not Applicable

9. On average, how many times per year does the unit supervisor hold a case conference review for each parolee?

- ◯ Never
- ◯ 1 Time
- ◯ 2 Times
- ◯ 3 Times
- ◯ 4 or More Times
- ◯ Do Not Know
- ◯ Not Applicable

Collaborative Orientation

1. Do law enforcement personnel in your district access the vendor data system to view the tracks of GPS-monitored parolees?

- ◯ No
- ◯ Yes
- ◯ Do Not Know
- ◯ Not Applicable

2. About how many times each month do law enforcement personnel personally request from you GPS information related to a reported crime?

- ◯ Never
- ◯ 1–2 Times
- ◯ 3–6 Times
- ◯ 7–9 Times
- ◯ 10 or More Times
- ◯ Do Not Know
- ◯ Not Applicable

3. About how many times each month do you personally contact law enforcement personnel to request assistance in monitoring parolees?

- ◯ Never
- ◯ 1–2 Times
- ◯ 3–6 Times
- ◯ 7–9 Times
- ◯ 10 or More Times
- ◯ Do Not Know
- ◯ Not Applicable

4. How would you rate the collaboration between law enforcement and CDCR with regard to the GPS program?

- ◯ Poor
- ◯ Below Average
- ◯ Average
- ◯ Above Average
- ◯ Excellent
- ◯ Do Not Know
- ◯ Not Applicable

Program Staffing

1. Approximately, how many hours of GPS training have you completed?

Hours of Training (Ex: 8)

2. How would you rate the overall quality of the training provided to you by CDCR?

- ◯ Poor
- ◯ Below Average
- ◯ Average
- ◯ Above Average
- ◯ Excellent
- ◯ Do Not Know
- ◯ Not Applicable

Summary

1. How would you rate your proficiency with the GPS monitoring system?

- ◯ Poor
- ◯ Below Average
- ◯ Average
- ◯ Above Average
- ◯ Excellent
- ◯ Do Not Know
- ◯ Not Applicable

2. Based on your knowledge of the GPS monitoring system, do you agree or disagree with the following statements:

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	DK	NA
GPS monitoring is a reliable tracking tool for parole agents.	◯	◯	◯	◯	◯	◯	◯
GPS monitoring is more time intensive than traditional parole supervision.	◯	◯	◯	◯	◯	◯	◯
GPS monitoring enhances traditional parole supervision.	◯	◯	◯	◯	◯	◯	◯
GPS monitoring diminishes the need for face-to-face parole supervision.	◯	◯	◯	◯	◯	◯	◯
GPS monitoring of parolees provides more public safety than traditional parole supervision.	◯	◯	◯	◯	◯	◯	◯
GPS monitoring decreases the criminal behavior of parolees.	◯	◯	◯	◯	◯	◯	◯
GPS monitoring increases the probability that the criminal behavior of parolees is detected.	◯	◯	◯	◯	◯	◯	◯

Evaluation of the GPS System for Monitoring Gang Offenders: CDCR

This survey is complete. Thank you for your help.

If you have any questions or concerns please contact

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