The York *Smart Policing Initiative*: Using a Data Driven Approach to Crime and Traffic Safety

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Introduction

The Smart Policing Initiative in York, Maine is the story of how a small police department embraced the use of crime analysis, data, technology, and geographic information systems to guide its deployment strategies. The evolution of the department was far from a linear progression; rather, it had its ups and downs and periods of inactivity and flourishes of engagement. Nonetheless, department officials remained steadfast in their belief that the problem-solving strategy and the Data Driven Approach to Crime and Traffic Safety (DDACTS) could assist them in their efforts to reduce traffic accidents and collisions. This report provides details about that evolution including the challenges and successes that occurred over a four-year period.

The York Police Department (YPD) received its Smart Policing grant in September 2011. Its original research partner dropped out of the project after about ten months and its replacement, Justice & Security Strategies, Inc. stepped in to assist the department about a year after the project began (November 2012).

Background

York, Maine is a coastal community in southern Maine and is similar to numerous beach and tourist towns and cities on the Eastern seaboard. York's year-round population of 14,000 increases to nearly 50,000 during the summer months. Interstate 95 and Route 1 are major roadways through York and Route 1A is a scenic coastal route traversed by tourists heading to northern Maine and beyond. The town is about one hour north of Boston. According to the Maine department of tourism, about 1.6 million people visited York beaches in 2013.

The York Police Department (YPD) provides public safety services to the community. YPD is comprised of 27 full-time officers, including four administrators, five sergeants, three detectives, 13 patrol officers, and two school resource officers. During the summer months 10 to 20 reserve officers are hired to assist with enforcement by patrolling the beach and keeping the peace. On average, during the year, the department handles about 19,500 calls for service, writes about 800 offense reports, makes 750 arrests, and investigates and reports on approximately 400 crashes.

The DDACTS method is an offshoot of the problem-oriented policing strategy (POP) first developed by Herman Goldstein in 1990. Rather than use the SARA process *per se* (Scanning, Analysis, Response, and Assessment) created by Eck and Spelman (1987), DDACTS has seven guiding principles that overlap with POP/SARA[1]:

1. Partners and Stakeholders Participation – partnerships among law enforcement and local stakeholders is essential
2. Data Collection – accurate data (crash, crime, calls for service, etc.) are the building blocks of DDACTS
3. Data Analysis – creating actionable analysis products, including maps that overlay crime, crashes, etc. assist in identifying problem locations.
4. Strategic Operations -- based on the analysis, law enforcement agencies are able to identify high activity areas (e.g., hot spots)
5. Information Sharing and Outreach – sharing information internally and externally keeps officers and partners informed about accomplishments

[1] http://www.nhtsa.gov/Driving+Safety/Enforcement+&+Justice+Services/Data-Driven+Approaches+to+Crime+and+Traffic+Safety+(DDACTS)

6. Monitoring, Evaluation, and Adjustments – data collection and analysis is continuous and provides feedback to supervisors to monitor, evaluate, and adjust strategies
7. Outcomes – goals and objectives that emerge from DDACTS become measurable; the measures demonstrate the effectiveness of the program

For York, the Smart Policing Initiative (SPI) allowed for the combination of DDACTS and POP/SARA into a singular effort.[2] The York SPI team comprised of a lieutenant, sergeant, two officers, and two civilians identified traffic accident hotspots and areas where speeding and traffic flow are problematic and then deployed a traffic enforcement strategy to reduce these problems. The SPI team established four major goals:

1. Reduce the number of traffic accidents.
2. Reduce the number of crashes associated with offenders under the influence of alcohol or drugs (OUIs).
3. Reduce crime associated with traffic incidents
4. Increase the safety of the streets and highways in York

Data, Software, and Technology

To scan and analyze the traffic and crime problems, the SPI team used traffic data, notably citations and accidents. York PD has a records management system and routinely submits accident data through the Maine Crash Reporting System (MCRS). These are location-based data. Data from the MCRS were used to construct the tables and maps. [A reportable traffic crash is defined "as any unintended event caused by a motor vehicle in motion that results in any injury, death, or property damage to the apparent amount of $1000.00 or more and which occurs on a traffic way."][3]

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[2] Within this report, DDACTS and POP terms will be used interchangeably.

[3] https://www1.maine.gov/online/mcrs/faq.html

Data on arrests, citations, and calls for service were analyzed using Tritech software. The software package yields intelligence bulletins regarding officer activity (citations, arrests, and accidents). Hot spot maps were generated through Tritech, with the assistance of the town of York's GIS specialist. The YPD does not have a full-time, crime analyst. Instead it relies upon a part-time civilian and officers to use Tritech, MS Excel and Access.

In addition two other innovative data collection tools were used – the Jamar Radar Recorder and automatic vehicle location devices (AVLs) on patrol cars. The Jamar Radar Recorder[4] is a black box that is placed on a telephone pole and not readily visible to drivers. The radar recorder allows the department to collect unbiased data without drivers changing their normal driving habits and skewing results. The technology monitors speed and traffic flow conditions during five-day periods around the clock. The data allow the department to effectively plan and alter traffic enforcement strategies. With this equipment, the department is able to determine the extent of speeding at specific times in specific locations. In addition, it is used to identify locations that have generated complaints of speeding vehicles that have not subsided with current enforcement plan. For example, the Jamar box was placed near an elementary school on York Street in January 2012. The posted speed limit for the area is 25 mph and 15 mph for the school zone twice a day. During the period of January 25 to January 30 over 54,000 vehicles were recorded. Data from the box give the number of vehicles that drove 1-25 mph, 26-30 mph, 31-35, and so on. During the five-day period, the average speed was 31.9 mph and 1,221 vehicles went over 40 mph. These data are useful because the department can: 1) place officers at specific times for traffic enforcement purposes, 2) provide data to the public about the nature of speeding in a specific area, and 3) evaluate interventions using the data.

[4] http://www.jamartech.com/index.html

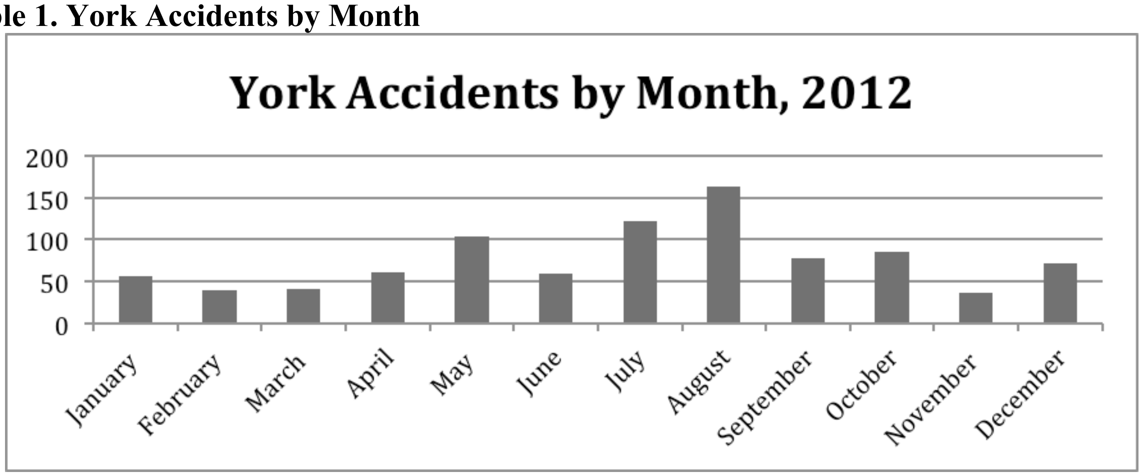
The automatic vehicle location devices (AVL) consist of GPS hardware attached to patrol vehicles with software that allows for tracking of the vehicles within hot spot areas. The AVL software provides the department with address-level vehicle location data. An additional feature is the ability to augment the detail of the supplied map data with customer supplied ESRI Shapefiles and aerial imagery files. Further, another feature allows the software to send speed violations, geo-fence information, and input notifications to others as emails and text messages.

The Problem

In York, traffic accidents and collisions are on-going problems, particularly during the summer months when the influx of tourists occurs. This section describes the scanning and data analysis phases, looking closely at data from 2012 when York first began to identify its problem. Analysis of traffic accident data from 2012 shows that 31% of them took place in July and August. Many of those took place along Route 1 (York Corner) and York Street.

In 2012, York reported 320 traffic accidents to the state of Maine. July and August accounted for about 31% of accidents occurring in that year. The closer to the summer months, the more accidents were reported. Table 1 shows the distribution of accidents by month.

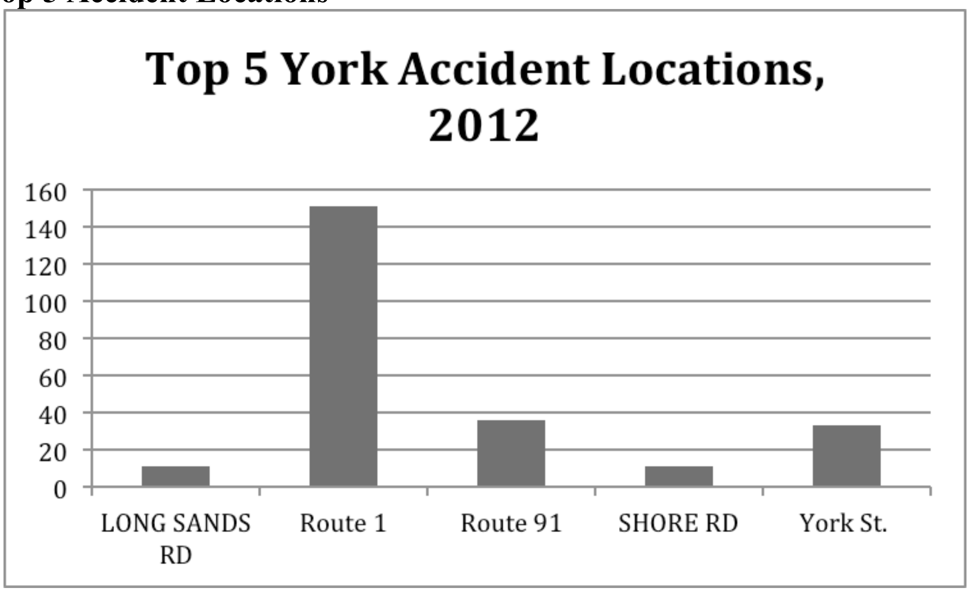
Table 1. York Accidents by Month



Locations

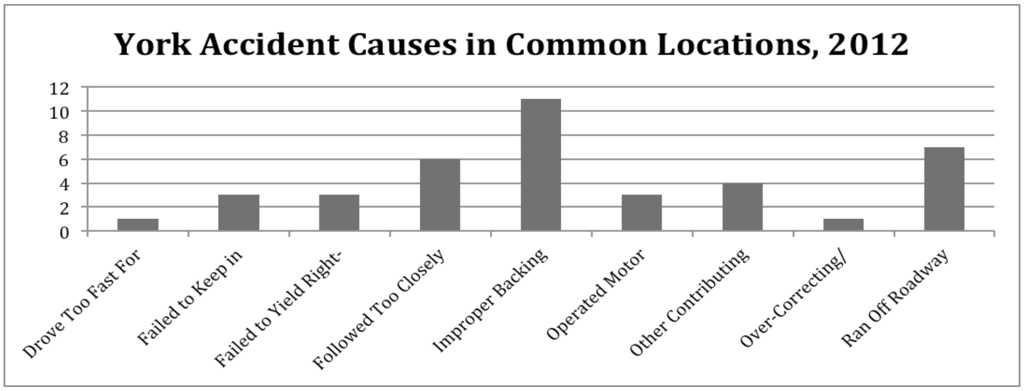
The top 5 locations for accidents in 2012 were Route 1, Route 91, Shore Rd, Long Sands Rd and York St. These locations accounted for 53.5% of all accidents in 2012. Route 91, Route 1, and York St. are the town's major roads to get to the beaches, surrounding towns, and Interstate 95.

Table 2. Top 5 Accident Locations



In those top 5 locations, the most common causes of accidents were improper backing, run off the roadway, and following too closely (Table 3). These three causes accounted for 62% of the accidents in the common locations.

Table 3. York Accident Causes



As part of the analyses a series of maps were created to visually show the crash hot spots. Figures 1 provides a map of the town of York and its boundaries and shows all of the crashes that occurred in 2012. The map shows the entire York area, the main thoroughfares that bisect the town going north and south (I-95 and Route 1), and the concentration of traffic crashes primarily along Route 1.

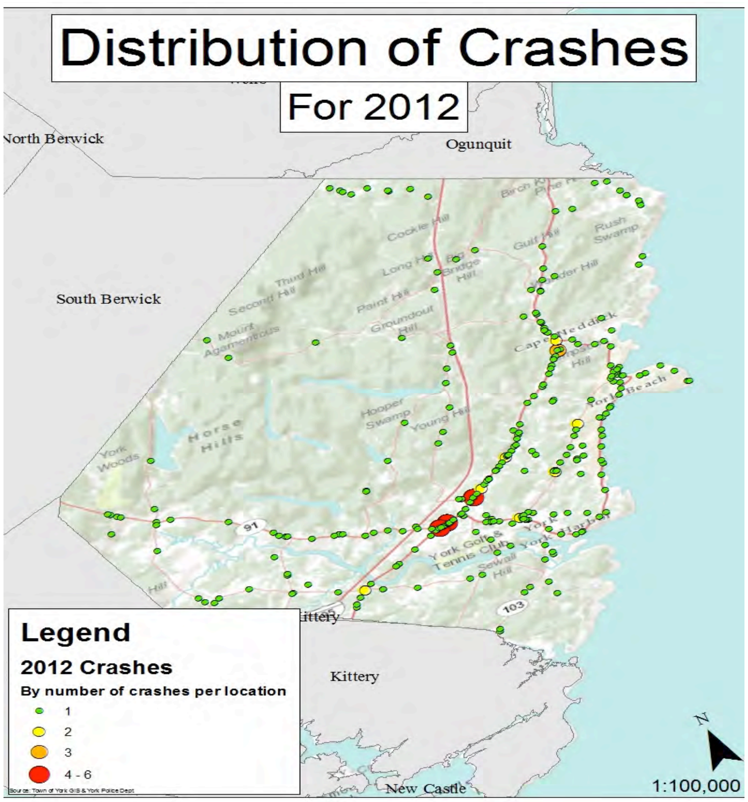


Figure 1. Town of York, ME and Crashes in 2012

Figure 2 focuses upon the crash hot spots and shows the major areas where crashed occurred in 2012. In the accident hotspots, the map shows that 97 crashes occurred in 1.18

square miles of the town of York. This equates to 31% of the crashes occurring in an area that equals 2.1% of the landmass for York.

Figure 2. Hot spot traffic areas in 2012

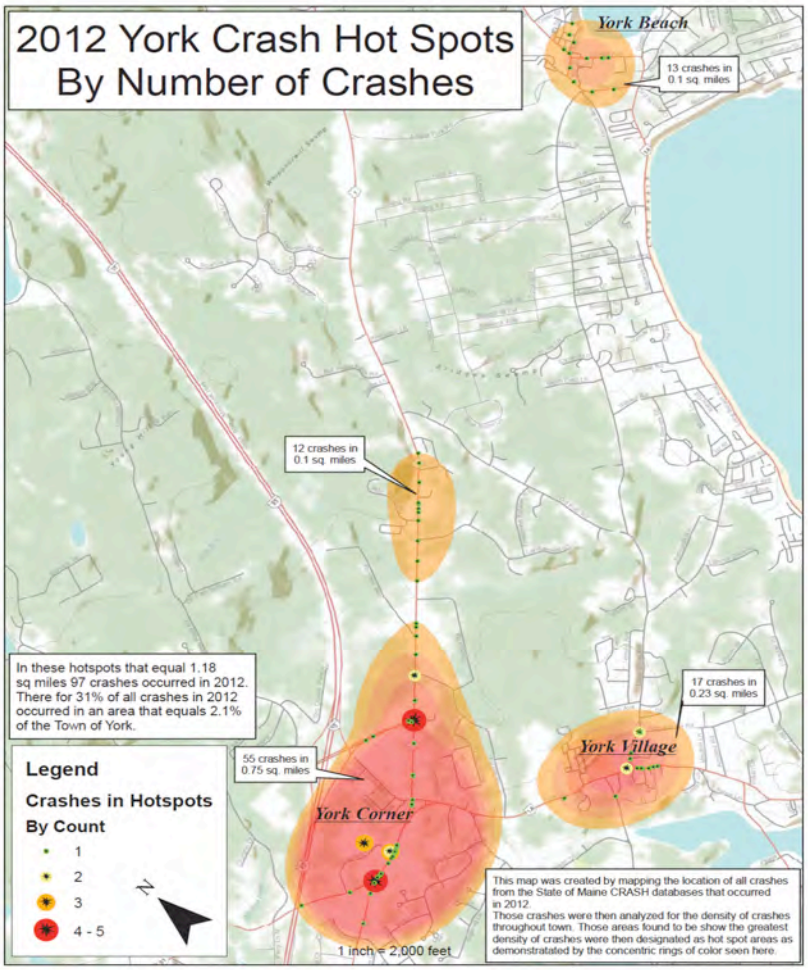


Figure 3 (below) shows the roadways where the crashes occurred:

- Cider Hill Road (in yellow) runs west to east and into I-95;
- Route 1 (in light green) runs from Spur Road to Cider Hill Road;
- Route 1 (in red) runs from Spur Road to Old Post Road;
- Route 1 (in orange in the northeast) runs from Wild Kingdom to Mt. Road; and
- York Street (dark green) runs from west to east to the beach area.

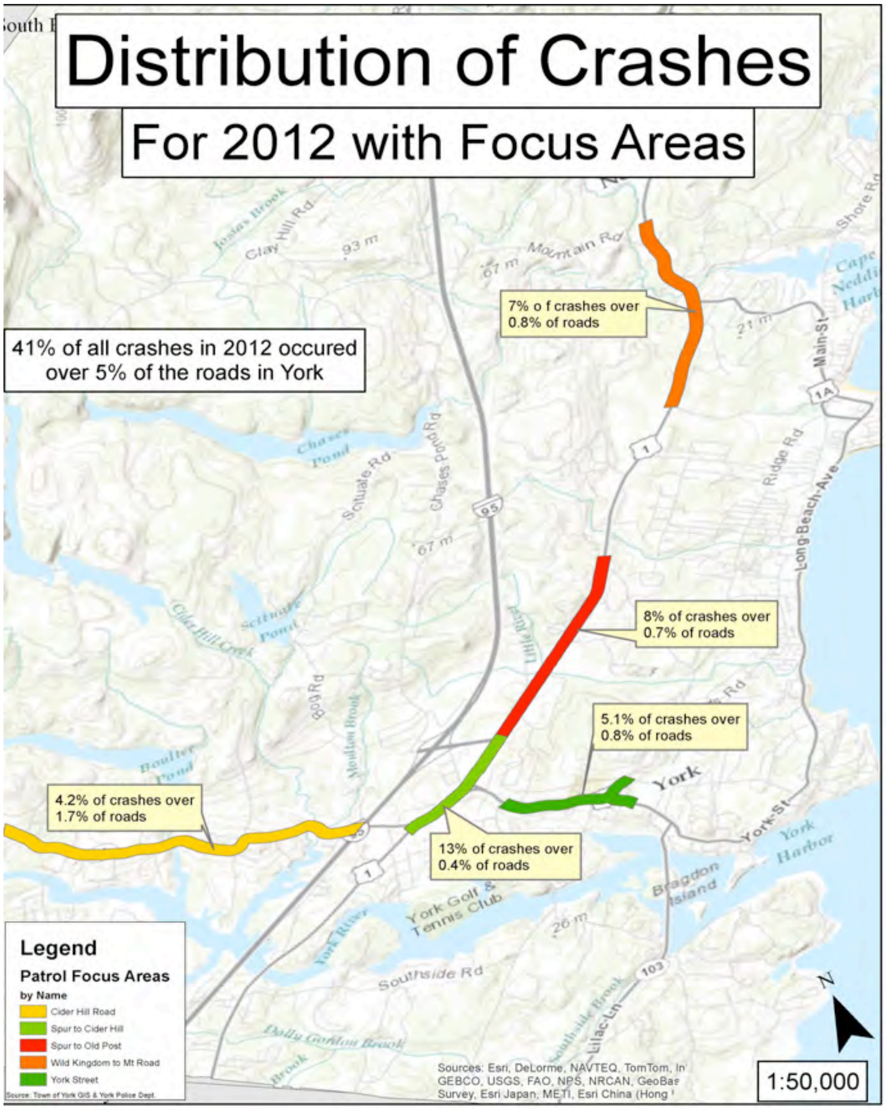


Figure 3. Distribution of Crashes in 2012

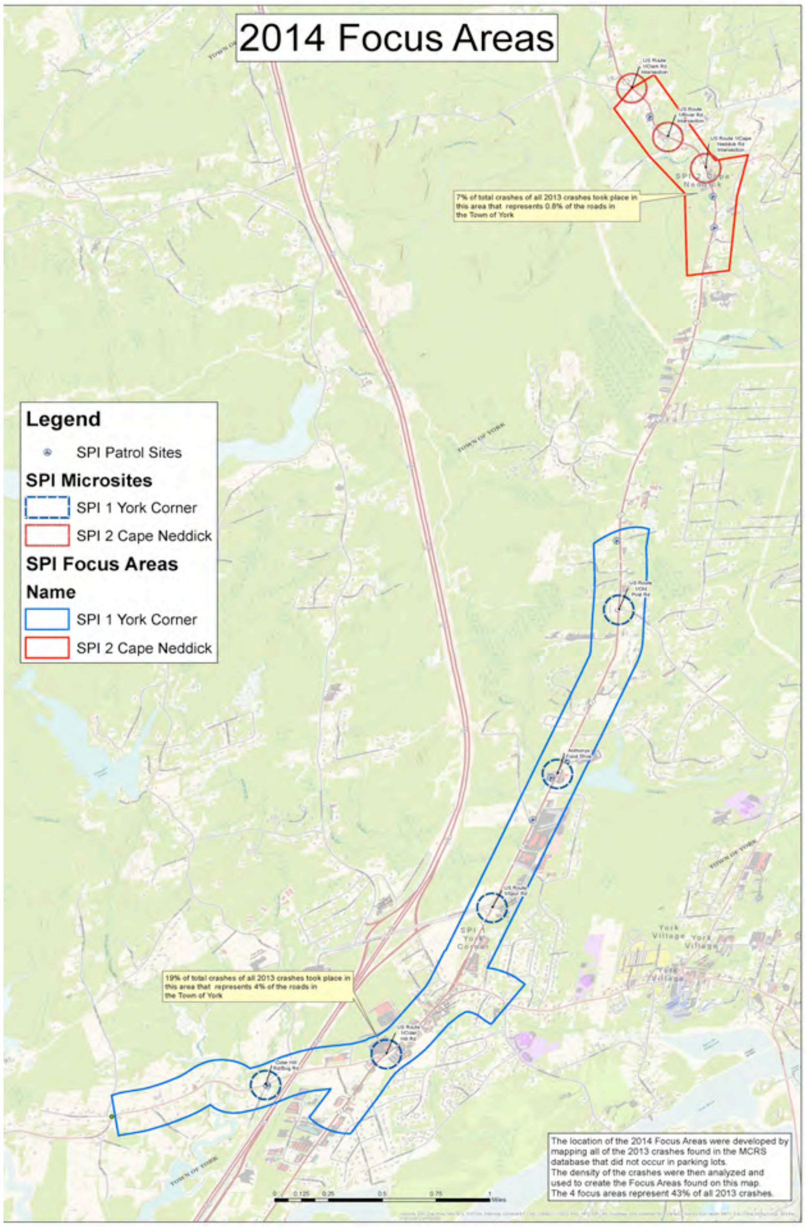
Figure 3 also indicates that 41% of all of the crashes in 2012 occurred on only 5% of the roads in York. Thus, the SPI team believed that focusing on these areas would have the greatest effect in reducing crashes and improving safety in York.

Interventions

The York Police Department determined that reducing traffic accidents would be a major priority for the summer season. Eight, one-officer patrol units were involved in the intervention. Officers were instructed to maintain a presence in specific areas. This meant parking in a location to write reports, sitting in other locations to work radar, and patrolling regularly along the specific roadways. The intervention period began on May 22, 2014 and ended on October 31, 2014.

Based on the maps created in May-October 2012 and refreshed using similar data and analysis from May-October 2013, YPD staff identified two Smart Policing Zones for the interventions. These were designated as SPI Zone 1 and SPI Zone 2. In the map below (Figure 4), SPI 1 is in blue and SPI 2 is in red. Within the geofences, additional 'microsites' (in circles) were designated as these were the specific locations that officers were instructed to work.

Figure 4. Focus Areas for Interventions



Police vehicles were equipped with AVLs and YPD tracked the vehicles using geofences within specific areas. The geofences are technically polygons that staff created to mimic the areas of town that represent the SPI zones. The Geofence Time Report module was used to extract the data. This reporting module provides the user with the ability to create a report that outlines the date(s) a vehicle or vehicles enter and exit geofenced areas, the percentage of time and the amount of time the vehicle spent inside a geofenced area, as well as how amount of time and percentage of time the vehicle was in service. The output for the report can be PDF, text, or Microsoft Excel format. These data were used for the analysis described in the next section.

Measuring Impact: Time Spent in the Intervention Areas

One of the advantages of the AVL data is that it is possible to directly measure the dosage of police patrol that is applied throughout the intervention. Although the AVL data were available for a brief period of time for analysis purposes, this measure constitutes a direct assessment of patrol activities over the intervention period and is more precise and accurate than previously possible. (Unfortunately, data were only available in September and October 2014 due to technical problems.) The use of geofences simplifies the task of determining the time spent by patrol units in the target areas over raw AVL data, as patrol activities can be measured by the amount of time spent within the geofence and outside the geofence. As a practical matter, we are able to document the amount of time spent in the intervention areas and provide direct feedback to units as a method to increase patrol dosage over time. The charts below present an example of the information that can then be disseminated to patrol units to illustrate the amount of patrol dosage provided to each location by unit. In the future, this information can be used to set optimal dosage levels for each intervention site and continually monitor how well patrol units achieve this optimal level of patrol saturation.

Tables 4 and 5 show the amount of dosage by patrol unit over September and October, 2014 in SPI 1 and SPI 2, respectively. In SPI 1, all eight units spent a total of 12,179 minutes over the 60-day period and in SPI 2, they spent 4,998 minutes. On average, over the 60-day period the patrol units spent 1,522.3 minutes per vehicle in SP1 and 624.8 minutes per vehicle in SP 2. More time was spent in SPI 1 than SPI 2 because SPI 1 was larger and had more microsites. The most active vehicle in SPI 1 was Unit 83 and in SPI 2 the most active vehicle was Unit 90. In October, Unit 84 spent an average of 24.3 additional minutes per day in SP 1 compared to September. This was the largest change in time spent in SP 1 between September and October. Similarly, the largest change in SP 2 was by Unit 90, which spent an average of 9.3 fewer minutes per day in SP 2 in October compared to September.

Table 4. Average Minutes in SPI 1

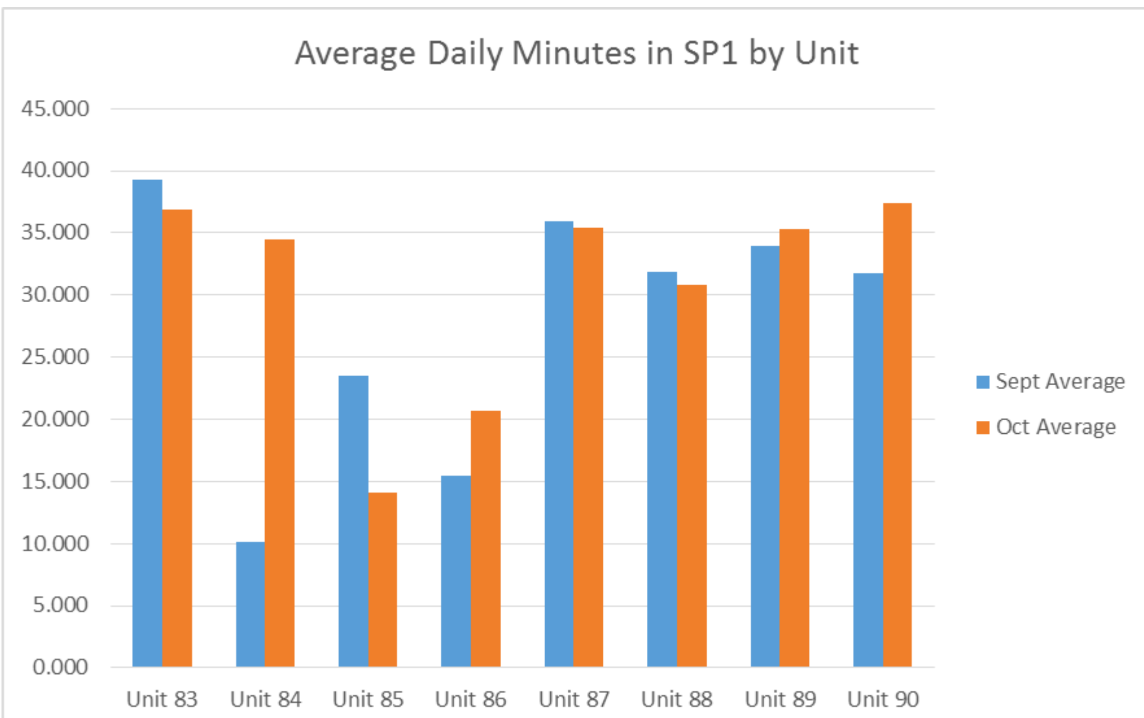


Table 5. Average Minutes in SPI 2

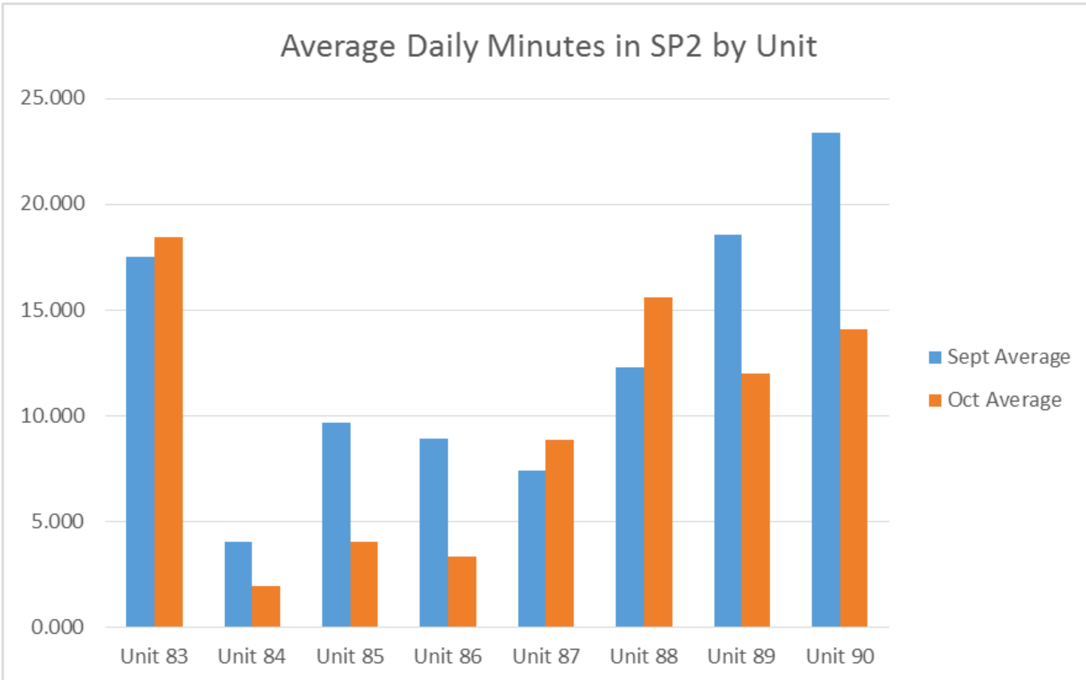
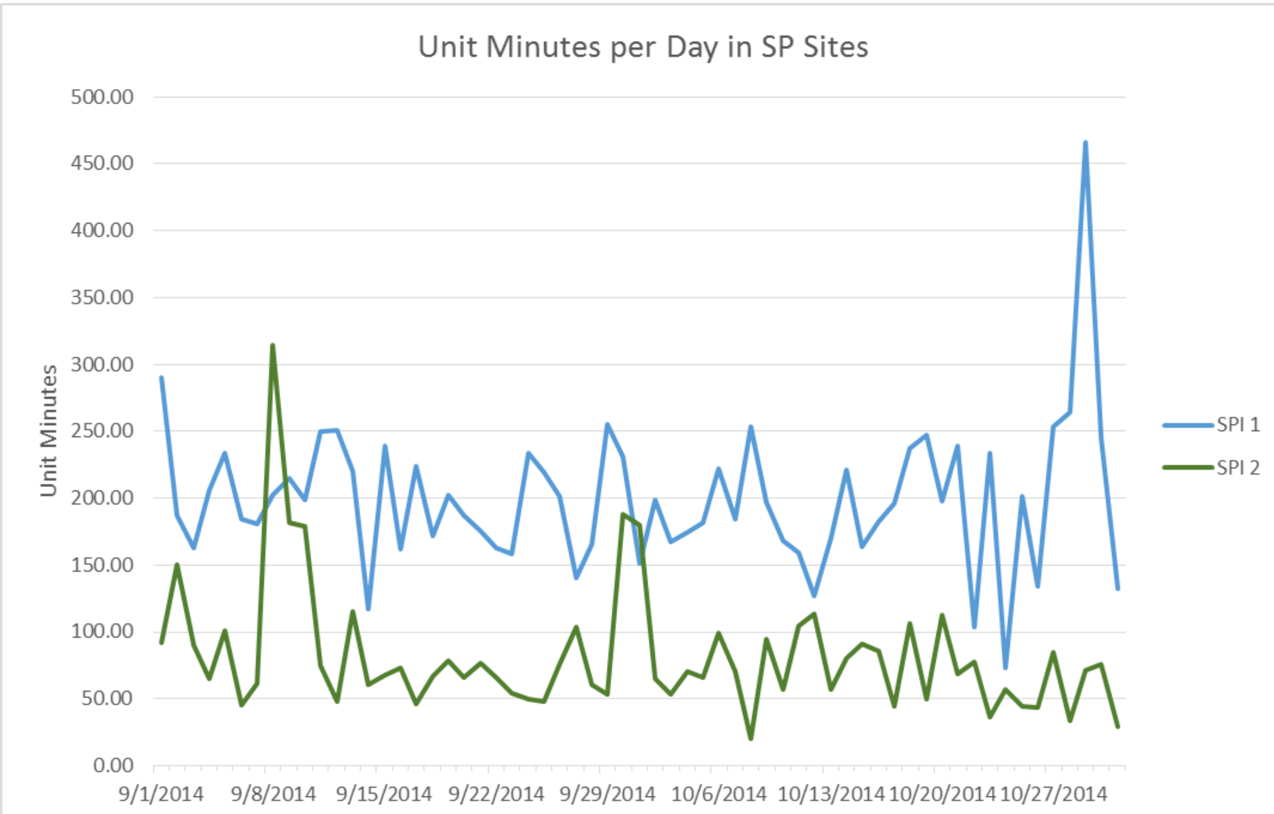


Table 6 shows a breakdown of dosage per day in SPI 1 and SPI 2. The mean amount of time per day for SPI 1 was 199.7 minutes and for SPI 2 the mean amount of time was 81.9 minutes. The peak in SPI 1 occurred on October 29 with a total of 466 minutes and for SPI 2 the peak occurred on September 8 with a total of 314 minutes. Neither date corresponded to major holidays, but were close to Labor Day and Halloween, respectively, and may reflect additional movement to or from York for these holidays.

Table 6. Unit Minutes per Day in SPI 1 and SPI 2



Time Series Analysis of the Intervention

As part of the evaluation of the strategy, YPD provided calls for service (CFS), traffic citations, and crash data. The data were aggregated monthly and spanned the time period of January 1, 2012 to October 31, 2014 (34 observations). CFS data were identified by the call location and only calls originating in SPI 1 or SPI 2 were used. In addition to the total number of calls for service within each of the SP areas, separate series for automobile-related and crime-related calls were also created. Crash data were also examined for this time period, but these were not separately identified by SP area prior to 2014, so only the total crash volume per month was examined. Finally, citation data were examined, but these again lacked SPI designations prior to 2014, so only the total number of citations over this time period was examined.

Following the research strategy outlined by Uchida and Swatt (2013), a series of segmented regression models were examined to determine whether the intervention impacted the number of vehicle crashes, citations, and calls for service. Specifically, negative binomial regression models were used for the monthly total number of crashes and citations across the jurisdiction and the monthly total number of calls for service and calls for service related to automobile incidents and disturbances/crimes at each of the intervention sites. Following the logic of the segmented regression design; the intercept captures the pre-existing average number of events, the coefficient for time captures the pre-existing trend in events, the coefficient for the intervention month captures the immediate shift in events in the month of the intervention, and the coefficient for the intervention x time interaction effect captures the subsequent change in trend following the intervention. Interventions with an immediate drop in events will have a significant, negative coefficient for the intervention. Interventions that result in a steady decrease in events over time (lower trend) will show a significant, negative coefficient for the intervention x time interaction effect. The results for these models are presented in Table 7 below.

Table 7. Segmented Regression Results

	Crashes		Citations		SP1 Total CFS		SP2 Total CFS	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Constant	3.444 ***	(0.151)	5.721 ***	(0.123)	5.213 ***	(0.102)	3.199 ***	(0.143)
Time	-0.002	(0.009)	0.005	(0.007)	0.014 *	(0.006)	0.036 ***	(0.008)
Intervention	0.437	(0.387)	0.405	(0.372)	0.224	(0.268)	0.479	(0.385)
Intervention x Time	-0.028	(0.094)	-0.062	(0.107)	-0.062	(0.065)	-0.120	(0.095)
Alpha	0.111	(0.034)	0.110	(0.027)	0.068	(0.017)	0.123	(0.035)

	SP1 Auto CFS		SP2 Auto CFS		SP1 Crime CFS		SP2 Crime CFS	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Constant	4.568 ***	(0.122)	2.632 ***	(0.182)	2.166 ***	(0.174)	0.241	(0.350)
Time	0.013 °	(0.007)	0.042 ***	(0.010)	0.017 °	(0.010)	0.029	(0.019)
Intervention	0.568 °	(0.325)	0.489	(0.490)	0.603	(0.377)	2.258 ***	(0.769)
Intervention x Time	-0.130	(0.079)	-0.154	(0.122)	-0.177 °	(0.092)	-0.923 ***	(0.288)
Alpha	0.095	(0.025)	0.196	(0.055)	0.103	(0.044)	0.238	(0.176)

° $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$

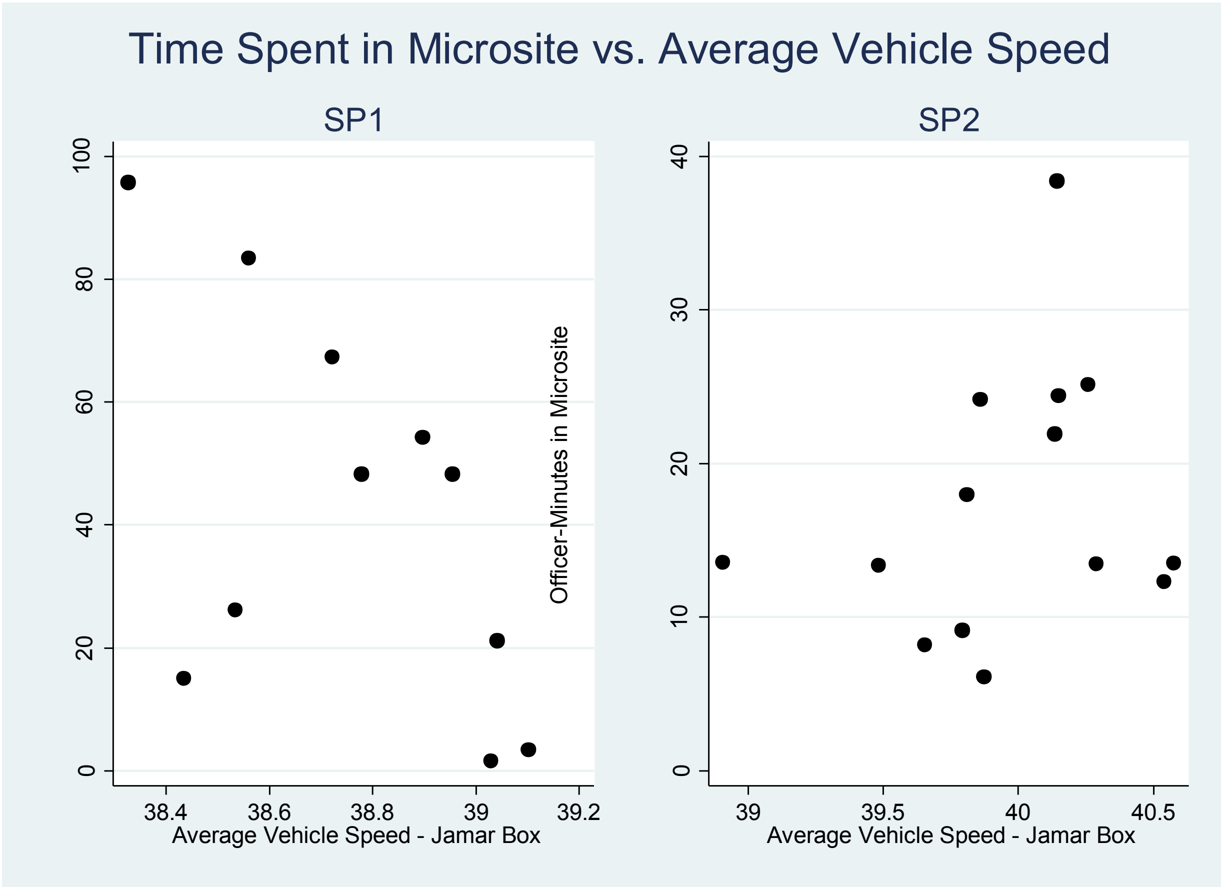
Findings

No intervention effects were observed on the total number of crashes and the total number of citations issued. Further, no intervention effects were observed on the total number of calls for service or automobile related calls for service in either intervention area. There is some evidence of an intervention effect in SP1 for the number of crime-related calls for service in both SP1 and SP2 as the intervention x time interaction effect was negative and marginally statistically significant in SP1 and negative and statistically significant in SP2. However, some caution is needed in interpreting these results as both locations showed a spike in crime-related calls for service near the time of the intervention. As such, it is possible that the observed effect is merely capturing a regression to the mean effect. Given the small number of post-intervention time periods, further study is needed to determine whether this decreasing trend continues in future time periods.

Analysis of Daily AVL and Jamar Box Data.

Jamar Radar Boxes were placed in the SPI 1 Cider microsite from 5/30/2014 to 6/9/2014 and in the SPI 1 Route 1 microsite from 5/27/2014 to 6/9/2014. AVL data are also available during this time period, so it is possible to examine the relationship between the daily amount of time spent in the microsites (in terms of officer-minutes per day) and the average vehicle speeds recorded by the Jamar boxes. Although only a small sample of days is available for analysis, the results of the analysis appear promising. In SPI 1, the correlation between time spent in the microsite and average vehicle speed is -0.558 and significant at the .10 level. This means that the more time that was spent in the microsite by patrol units, the average vehicle speed of drivers decreased. In SPI 2, however, the coefficient is 0.242 and not statistically significant. A scatterplot illustrating these correlations is presented below. This analysis is seriously limited by the small sample size, but the results suggest more investigation is warranted and that additional time spent in the microsites may have benefits in reducing vehicle speed.

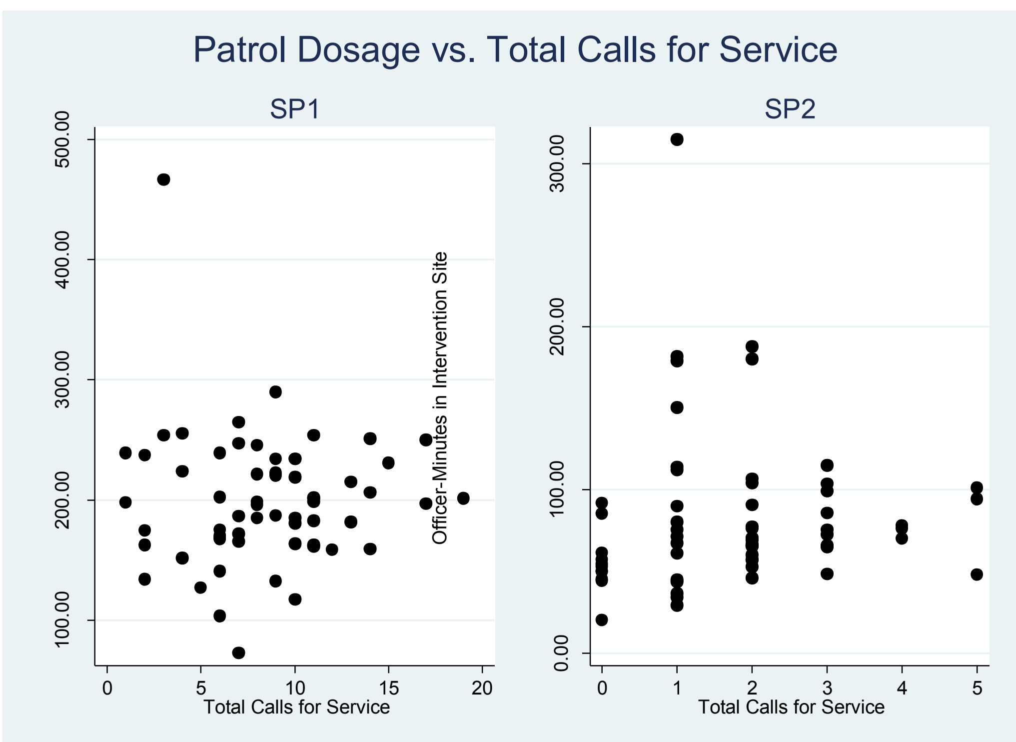
Figure 5. Time Spend in Microsite and Average Vehicle Speed



Analysis of Daily AVL and CFS Data

Due to equipment failure, AVL data during the months of July and August 2014 were unavailable. However, continuous AVL data were collected during the months of September and October of 2014. For these months, it is possible to examine the relationship between time spent at the intervention and calls for service on a daily basis. Given the low daily call volume (approximately 7.9 CFS per day in SP1 and 1.6 CFS per day in SP2), only the total calls for service were examined. A scatterplot of the officer-minutes spent in the intervention site against the total number of calls for service for SP1 and SP2 is presented in Figure 6 below. Both correlation coefficients for SP1 (-0.018) and SP2 (-0.083) were non-significant, suggesting that there is no relationship between patrol dosage and calls for service. It is important to recognize that this analysis is substantially limited by the lack of statistical power with a small number of observations, an attenuated range in the level of patrol dosage applied, and a dependent variable that does not distinguish between call types. Further, prior research finding that targeted hotspot patrol reduces crime suggests that the effect of patrol dosage on crime may be non-linear and the relationship becomes considerably stronger at higher dosage levels. This analysis does, however, illustrate how AVL data can be coupled with calls for service or crime data to better delineate the relationship between patrol dosage and crime prevention. Further research may provide substantial guidance to police administrators in determining an optimal level of dosage that maximizes the crime prevention effect of patrol and minimizes the impact of diminishing returns with additional manpower expenditures.

Figure 6. Patrol Time and Total Calls for Service



Conclusions

Overall, the findings from the interventions are inconclusive and we did not find reductions in the number of traffic accidents, crashes, or crime associated with traffic incidents. This was not due to implementation failure or lack of effort by York patrol officers. They followed instructions and were in the SPI zones during the summer months. Unfortunately, because of problems with the equipment, we could not routinely measure how much dosage occurred and the effects of their presence on traffic, crashes or crime.

But, the AVL data and geo-fences along with the data from the Jamar boxes provide a unique methodology for estimating the dosage associated with DDACTS interventions at each of the target sites. While some of the results appear promising, unfortunately limitations in statistical power arising from the small sample sizes associated with a limited amount of post-intervention observations and daily observations make it premature to determine whether the intervention was successful at reducing criminal activity. Clearly, further study is warranted not only to assess the success of the intervention, but also to better understand how these technologies can be used to improve police service delivery on a regular basis.

The York Police Department, however, has valuable tools to measure its interventions objectively. Using geofences, and accessing data from AVLs, calls for service, arrests, citations, and crashes give the department a comprehensive view of how to analyze problems, when to intervene, and how to assess and evaluate those interventions.

Lessons Learned

The Smart Policing Initiative provided the York Police Department with an opportunity to systematically engage in problem oriented policing and DDACTS and to work with a research partner over a four-year period. YPD had not previously engaged in crime analysis and research and evaluation, nor had it worked with BJA or a training and technical assistance contractor. Through the project, YPD gained experience and knowledge along a number of areas, including, data, technology, analysis/research, and training and technical assistance.

Data and Technology

YPD has an abundance of data and has begun to harness that information through hardware and software. Like other agencies both small and large, the department routinely collects calls for service, traffic citations, crashes, arrests, and incident data. ArcGIS, Jamar boxes, automatic vehicle locators, geofences, Microsoft Excel and Access, and a records management system are among the various tools that are available for use in the department to collect and analyze those data. Through the grant the department was better able to understand the value of the data and to begin to use its tools effectively. While there were challenges in using the data and technology, YPD has overcome them and is on path to use its data and technology routinely.

Crime Analysis and Research

The core principle of Smart Policing, POP, and DDACTS is the ability to collect and analyze data. Crime analysis was not a prominent feature in YPD prior to the grant. And while YPD does not have a full-time or part-time crime analyst, a group of officers and civilians led by a lieutenant and sergeant, took on the responsibilities associated with an analyst. The SPI team identified traffic collisions and accidents as the major problem during summer months, and through crime analysis, determined that the problem was tied to chronic hot spot locations. The SPI team developed strategies that were location-based and used new data and technology to assist in dealing with that problem.

Through this experience, the department recognizes the value of data and analysis for strategic and operational purposes. The lieutenant and sergeant now ask strategic questions about where and when officers should be in specific locations and how to measure those activities. Dosage and geofences are now a part of the language of the department. Furthermore, crime and intelligence reports and crime maps with hot spots can be generated easily.

Prior to the grant, YPD had limited knowledge and working experiences with a research partner. While the original research partner dropped out of the project, the new partner made a commitment to guide and enhance the abilities of YPD to understand and use research findings and to show the value of research methods in demonstrating the efficacy of different strategies.

Training and Technical Assistance

YPD effectively made use of the training and technical assistance provided by BJA and CNA, the SPI Contractor. Through CNA, Subject Matter Expert, Ms. Julie Wartell, and Training Instructor Mr. Christopher Bruce provided invaluable assistance over the grant period. Technical assistance in the form of site visits and 'hands-on' teaching by Ms Wartell provided YPD staff with information about its data and technology. Similarly, Mr. Bruce provided training sessions on crime analysis, mapping, and Microsoft tools (Access and Excel) that enabled YPD to understand and *use* their tools.

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