U.S. Department of Justice
Office of Justice Programs
National Institute of Justice

National Institute of Justice

Research in Brief

Jeremy Travis, Director

February 1997

Evaluation of Pepper Spray

by Steven M. Edwards, John Granfield, and Jamie Onnen

Issues and Findings

Discussed in the Brief: The implementation process and field test results of a project to evaluate the effectiveness of pepper spray in police confrontations with humans and animals. A research team from the International Association of Chiefs of Police analyzed Baltimore County Police Department policies, implementation training, and use of pepper spray from July 1993 to March 1994.

Key Issues:

● Whether OC spray can effectively incapacitate humans—including those who are intoxicated, drugged, or mentally disturbed—in confrontations with police.

● Whether OC spray can reduce the number of assaults against police attempting to subdue or arrest hostile/aggressive subjects.

● Whether OC use helps to reduce injuries to both officers and suspects in encounters between the two.

● Whether police use-of-force or brutality complaints are lodged less frequently due to use of OC.

● Whether OC is effective in neutralizing attacking or threatening dogs.

Key Findings:

● OC spray successfully incapacitated humans in 156 out of 174 (90 percent) confrontations.

continued p. 2

Violent encounters between police officers and individuals resisting arrest have historically resulted in injury and frequently in complaints about the level of force used by police. In addition to concern over these issues, increased civil liability and court-imposed limitations on the use of deadly force have stimulated the search for safe and effective less-than-lethal (LTL) force alternatives. One widely used option is oleoresin capsicum (OC) aerosol, commonly called pepper spray.

Despite extensive applications in hundreds of police departments, few systematic studies of OC usage and effectiveness have been documented. A National Institute of Justice-sponsored assessment of pepper spray's usefulness focused on the Baltimore County Police Department's (BCoDP's) operations from July 1993 through March 1994.

A research team from the International Association of Chiefs of Police (IACP) analyzed the BCoDP data and found that the use of OC in arrest and other confrontational encounters effectively neutralized aggressive suspects and animals. Study findings also suggest that the use of OC reduced the incidence of assaults on police officers, injuries to both officers and suspects, and use-of-force or brutality complaints registered against BCoPD.

This Research in Brief compares OC spray to other chemicals used in law enforcement and discusses the BCoPD study in terms of methodology, implementation issues, and assessment results.

Chemical weapon use in law enforcement

For centuries, various forms of chemical agents have been used in war as offensive weapons. As early as 2300 B.C., Chinese armies dispersed enemy forces by using "stink pots"—red pepper burned in hot oil that produced irritating and suffocating smoke—in massive frontal assaults. After World War I, however, an interest in extending the use of chemicals into the realm of law enforcement emerged. It was hypothesized that these agents could control criminals and riotous crowds as effectively as they controlled enemies during warfare. The three chemicals—chloroacetophenone, *o*-chlorobenzylidene malononitrile, and oleoresin capsicum—that have been used in law enforcement have shown major practical differences.

• **Chloroacetophenone (CN).** CN is a powerful lacrimator and respiratory irritant. Exposure to CN causes copious, uncontrollable tearing; difficult, shallow breathing; chest tightness; stinging sensations on the skin; and nausea. Psychological effects of fear and panic may also

- In 18 encounters, subjects were not fully "subdued " by OC; in 7 of these incidents, subjects exhibited bizarre behavior and appeared to be on drugs or mentally troubled, thus suggesting that such individuals may not yield to OC's effects.
- While assaults on officers were declining prior to implementation of the OC spray program, the rate of decline increased after OC was introduced.
- Twenty-one officers received minor injuries when they used the spray, but none reported lost work days.
- Similarly, only 14 suspects received injuries, none of which required hospital treatment.
- Use-of-force complaints decreased by 53 percent in the study period despite decreased manpower and increased demand for services. No complaints addressed the use of OC.
- Although training instructions stated that sprays were maximally effective from a distance of 4 to 6 feet, many officers applied the aerosol to humans from distances of less than 3 feet, which may have diminished the spray's effectiveness.
- Overall, study findings showed that a well-developed OC-spray program can provide operational benefits to police.

Target audience: Law enforcement officials and trainers; State, local, and Federal policymakers; researchers.

occur. As an irritant that relies on pain compliance, CN is most effective on those individuals who are lucid and have a normal pain threshold. Individuals who are intoxicated, extremely agitated, or mentally ill generally are less affected by the agent because of their greater tolerance for pain.

Although humans are susceptible to the agent's effects, animals suffer little, if at all, from the symptoms induced by CN. In addition, CN effectiveness is temperature-dependent. While the agent is useful in any temperature over 50° F, it is most effective when used in temperatures of 72° F and higher.

CN use also creates decontamination problems since the microscopic particles can remain airborne for some time after being dispersed. Dissipation time depends on the amount of the agent released, air current activity, temperature, and humidity. Finally, CN cross-contamination between subjects and police officers is common. Officers note that they are often contaminated by the agent when arresting and transporting sprayed subjects. This cross-contamination is thought to be responsible for officers' reluctance to use CN.

• ***o*-Chlorobenzylidene malononitrile (CS).** CN was replaced as a riot control agent by the U.S. Army and the National Guard around 1960. Officials believed that the replacement, CS, sometimes called super tear gas, was considerably less toxic and delivered more immediate effects than CN. Following military protocols, American law enforcement agencies subsequently adopted CS in 1965. Like CN, it is classified as a solid, not a gas, since it requires a carrying agent to disperse it into the desired target area. CS, a lacrimating irritant, immediately affects the mucous membranes, producing tears, runny nose, and persistent coughing or sneezing. Additional symptoms of exposure include respiratory distress accompanied by tightness in the chest, a burning sensation on the skin, and nausea or vomiting. In addition to physical effects, CS can also cause intense fear, panic, and cognitive disorientation.

Like CN, CS is more effective on those areas of the skin that are moist and is virtually ineffective on animals. Unlike CN, CS is considered to be effective over a wide temperature range. The microparticulate nature of CS results in agent persistency and thus can make decontamination problematic, especially in enclosed or confined spaces.

Serious injury to an individual is improbable if CS is used properly. Extensive toxicological testing indicates that, in spite of the potency of CS, it is safer, less toxic, and more effective than CN.

• **Oleoresin capsicum (OC).** OC, a naturally occurring substance derived from the cayenne pepper plant, is classified as an inflammatory agent. On contact with OC, the mucous membranes of the eyes, nose, and throat immediately become inflamed and swollen. The symptomatic swelling produces involuntary eye closure due to dilating capillaries; nasal and sinus drainage; constricted airway; and temporary paralysis of the larynx, causing gagging, coughing, and shortness of breath. The extract of peppers causes the blood vessels to dilate and the blood to rush to the upper body; the skin appears inflamed, resembling a burn.

OC's inflammatory properties purportedly render the agent more effective than CN and CS on violent, intoxicated, drugged, and mentally ill individuals. Moreover, the symptomatic eye closure and constriction of the respiratory tract explain why OC is so effective on animals. No

special decontamination protocols are required for OC because it is biodegradable. Unlike CN and CS irritants, OC will not persist on clothing or affected areas.

Examination of a national sample of in-custody deaths that occurred subsequent to OC use has excluded the agent as a contributory factor. This analysis concluded that, to date, OC has not caused any deaths.[1] Finally, OC use does not result in dermatitis, skin depigmentation, or burns.

CN and CS are still used by many law enforcement agencies, especially for tactical use in crowd-control situations. Primarily because of the potential risk of injury and cross-contamination, as well as decontamination problems associated with their use, law enforcement officials began to use OC as a less harmful, more dependable alternative. Although available since the mid-1970s, OC was not widely used until recently.

Study method

Research staff adopted a two-pronged approach to the OC spray evaluation task, which they initiated in mid-July 1993. The first phase involved examination of OC adoption and implementation issues. The second stage was concerned with assessing the impact of OC spray in confrontations between police officers and citizens, as well as police officers and dogs.

Phase 1. Officers and command staff members who initiated and were critically involved with the project met throughout the study period to address specific OC-related issues. Research staff attended these meetings and collected information on the process of OC adoption and implementation. Issues included selection of the pepper spray product, development of a written policy on its use, development of a training program and materials, implementation of documentation for reporting pepper spray usage, and identification of followup training needs.

Phase 2. Project data were provided by BCoPD's Crime Analysis Unit and Internal Affairs Section, as well as by the monthly *Maryland Law Enforcement Officers Killed or Assaulted* data sheets. This information was supported by data collected from an instrument developed by the research staff to track each spraying incident.

Every officer discharging OC spray in a confrontational encounter was required to complete the OC spray data collection form, which contained both open-ended and specified-choice questions relating to prevailing weather conditions, suspect's behavior, OC application area, injury (if any) received, and decontamination. The OC data form was completed along with a departmental incident report as soon as practical after conclusion of the encounter. A second data collection instrument, an unstructured followup interview, was developed to validate information collected by the OC data form. These unstructured officer interviews were conducted by the onsite observer to allow for the addition of any comments, suggestions, or officer observations regarding the specific encounter and the effectiveness of the spray.

Prior to their use in BCoPD, the OC data collection sheet and unstructured followup interview format were pretested in the Anne Arundel County, Maryland, Police Department. Results indicated that measurement instruments were both suitable and easily completed.

Findings: adoption and implementation

Selection of product. The Baltimore County Police Department had previously undertaken a thorough study of the OC product that it wanted to provide its officers. BCoPD selected a product containing a 5-percent concentration of OC delivered through a fogger system, which does not require precision aiming.

BCoPD training. The Baltimore County Police Department has sole responsibility for delivery of police services to approximately 695,000 people who reside in urban, suburban, and rural settings within its 612 square-mile jurisdiction. Eighty percent of the department's officers are assigned to the Field Operations Bureau, and they responded to 442,436 calls for service in 1993, which included 44,074 Part I offenses. The department needed to train approximately 1,400 officers in a 3-hour block of instruction—without disrupting assignments, affecting manpower, or incurring payment of overtime. To minimize disruption, OC training was incorporated into officer inservice firearms training, which began on July 12, 1993, and continued through December 31, 1993. During this time, 1,345 officers were trained in the use of OC spray and issued canisters.

Standard operating procedures. The BCoPD committee charged with examining the feasibility of OC adoption drafted a Standard Operating Procedure (SOP), following consultation with BCoPD's legal counsel, training officers, Internal Affairs, and command and staff officers. Additional directives were added following the completion of instructor training and writing of the lesson plan. The SOP requires all members of BCoPD whose

normal duties include making arrests or supervising arrest situations to carry OC spray. Uniformed members of the department are to carry the device on their gun belts in an issued holster, while nonuniformed officers are to carry pen-sized containers after completing a training program and demonstrating their competence in handling and using the OC spray.

Guidelines for usage. BCoPD, like most other police departments, adheres to the use-of-force continuum and its range of response, beginning with the mere presence of an officer and escalating to the use of deadly force. According to BCoPD procedures, OC spray may be used by an officer in any arrest situation when:

- The aggressor has failed to comply with the officer's verbal instructions.
- The aggressor has been advised of OC's impending use.
- The officer is about to use hands-on tactics to defend himself against active hostile resistance.
- The officer is confronted by an aggressive animal.

BCoPD thus places the use of OC spray above verbal commands on the force continuum as a means of control and restraint. BCoPD emphasizes that OC is not a substitute for a firearm. If, when faced by an armed individual, the officer deems deadly force necessary, then BCoPD considers the firearm to be the weapon of choice.

During the study, patrol officers voiced concern about whether they would be allowed to use deadly force if attacked with OC spray. The Legal Officers Section of the IACP holds that an officer may use deadly force to protect himself from the use or threatened use of OC spray when reasonably sure that deadly force will be used against him if he becomes incapacitated. Incapacitation includes situations in which officers may be unable to adequately defend themselves due to the effect of chemical sprays. Criteria for determining when to use deadly force incorporated situations in which OC was used against police (see "Reasonable Use of Deadly Force").

The Baltimore County Police Department operating procedures also outlined how to use the product and decontaminate the prisoner after use. The SOP directs officers to assure the suspect of the temporary nature of OC's effects and to provide air and water as first aid. BCoPD officers were instructed to remove the sprayed subject from the spray area into fresh air and to allow access to "copious amounts" of water, as soon as possible. Since BCoPD patrol vehicles did not carry water or any special equipment to aid in the decontamination process, they relied on physically removing suspects, instructing sprayed persons not to rub their eyes, and transporting them quickly to a source of water.

Use of pepper spray

During the study period, Baltimore County officers used OC in response to 194 (174 human and 20 animal) incidents, which fell into various categories of complaints that beat police officers often handle. These types of complaints usually involved aggressive, excitable behavior on the part of both the complainant and victim. Moreover, they tended to escalate quickly, resulting in confrontational outcomes.

Thirty-nine percent of the incidents occurred inside some structure (e.g., house, car), while the remaining incidents occurred "out-of-doors."

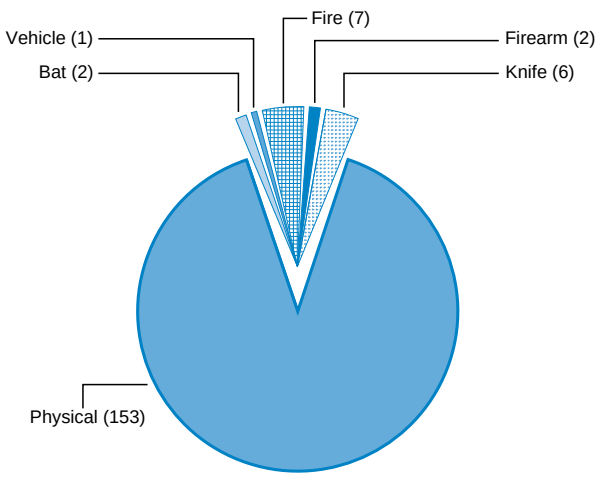
Reasonable Use of Deadly Force When Officers Are Attacked With OC

When a criminal attacks an officer with OC spray, he does so with the intent to harm the officer, escape, or both. It is common knowledge that a high percentage of officers who are incapacitated or have had their guns taken away are later shot with their own weapons. To ask an officer to take a chance that the OC spray attacker is going to walk away after incapacitating the officer would be, in the opinion of IACP's Legal Officers Section, unconscionable.

In determining whether an officer's use of deadly force was reasonable, the following factors may be considered:

- The nature of the crime committed by the person or persons confronting the officer.
- The nature of the verbal or physical threats posed by the person confronting the officer.
- The relative strength and fighting skills of the officer and his opponent.
- The number of officers versus the number of potential assailants.
- The nature of weapons in the possession of or available to the assailant.
- The ability to circumvent the potential effects of OC spray.
- The alternative means of defending against the use/effects of OC spray.
- The availability of assistance from other nearby officers.

Exhibit 1: ***Force / Threat Used by Suspect***



Weather conditions did not seem to influence either an officer's decision to use OC or the spray's effect on suspects. Eighty-four percent of the human subjects sprayed were male and 16 percent were female. Generally, sprayed individuals were intoxicated (drugs or alcohol), belligerent, and/or combative. The majority (89 percent) of incidents involved suspects who physically threatened the police officer; very few incidents involved the use of firearms or knives. The arrest/intervention incidents necessitating the use of the spray were primarily battery, assault, and disorderly conduct (see exhibits 1 and 2).

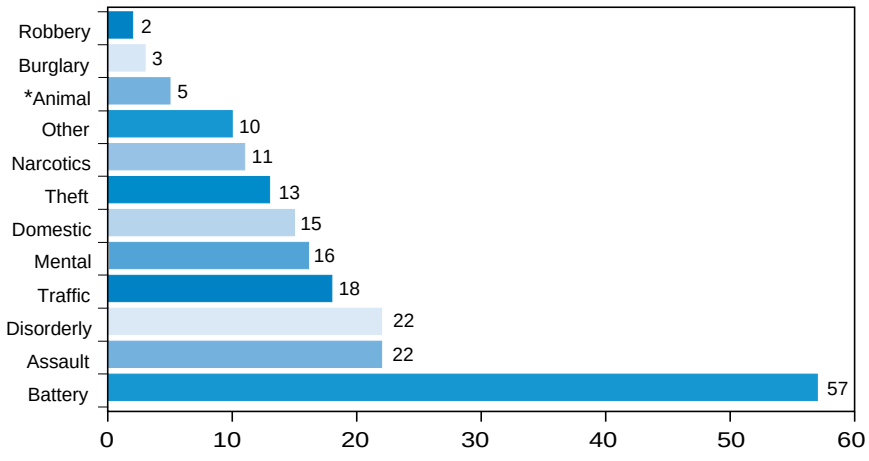
Effectiveness of OC use

Overall, OC was very effective in the 194 incidents where it was used (see "Officers' Comments on OC"on page 6). A total of 156 (90 percent) of the 174 individuals sprayed were incapacitated enough to be effectively arrested. Data indicate that almost all officers applied OC to the suspect's face, as they had been directed in training. However, officers generally did not spray from a distance of 4 to 6 feet as instructed. In 144 incidents, the spray was activated at a distance of 3 feet or less; in 102 of these, OC was sprayed at a distance of 2 feet or less. As a result, OC may not have been maximally effective.

Yet the data show that OC worked even if it was not sprayed from the distance suggested by the manufacturer. In 144 incidents, only one spray was required to incapacitate a subject; officers used the full contents of an issued container of OC to control suspects in four separate incidents. No data indicated that spraying more than one short burst produced better effects, if the subject were given a "good" spray the first time. The data showed that 117 individuals (67 percent) were classified by officers as submissive after the OC had been applied; 27 individuals (16 percent) were listed as complying with officer instructions after being sprayed (see exhibit 3). The difference between the terms "submissive" and "compliant" is subtle,[2] and it might be more appropriate to collapse the two categories into one. When the categories are collapsed, 144 (83 percent) of the 174 subjects were sufficiently neutralized to yield to officer orders. Thirty individuals (17 percent) struggled or otherwise failed to follow officer instructions.

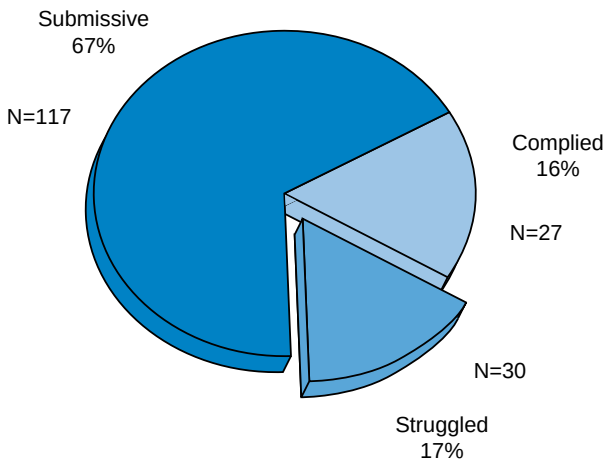
Eighteen of these 30 struggling subjects were classified by officers as not fully incapacitated by the OC spray. According to officer reports, the OC had no effect on seven suspects. These

Exhibit 2: ***Initial Contacts***



* A total of 20 incidents involved animals, but 15 of these were initially classified (at the time the call was dispatched) in other categories, such as "assault" on police officer.

Exhibit 3: ***Suspect Actions After Application***



seven individuals exhibited drugged behavior or seemed to have emotional problems. These data indicate that individuals who are heavily intoxicated, drugged, or mentally unstable may be resistant or immune to OC's effects or that OC may actually exacerbate the difficulty associated with controlling such persons.[3] Additionally, these types of encounters may cause the officer to be cross-contaminated if the incident escalates to a physical confrontation. BCoPD's experience indicates that training officers may want to stress the importance of accurately assessing the likely impact of pepper spray in such an encounter and of being prepared to select another control alternative.

Animal control. Interest in OC's effectiveness in animal encounters was high because, prior to project implementation, BCoPD had experienced a number of incidents where officers were forced to shoot threatening or attacking dogs. During the OC field study, dogs were sprayed with OC in 20 incidents where the animals posed a danger to officers. Ten of the dogs sprayed weighed between 25 and 50 pounds, and 6 weighed more than 50 pounds.

Data showed that officers sprayed the dogs at distances greater than those from which they sprayed humans. The majority of dogs were sprayed from a distance of 3 to 8 feet, whereas most humans were sprayed from a distance of 1 to 3 feet. The difference in application distances may account for the differences in the effectiveness levels for dogs and humans. OC was effective nearly 100 percent of the time in dog encounters (one officer was bitten but required no medical treatment).

Other results of OC use

Assaults on officers. Three years of prior assault data (pre-OC data) were collected for comparison with data from the period after which OC was adopted by the department (post-OC data). The pre-OC data were examined to identify any possible trends regarding assaults. Overall, these data showed that officer assaults were decreasing prior to OC use. The post-OC data indicated that assaults continued to decline. In fact, the total number of officers assaulted in the post-OC period was substantially lower than in any pre-OC data period. While it is likely that the introduction of OC spray contributed to this significant decline, the finding must be considered preliminary, since the pre- and post-data for this study were not strictly comparable in all cases.

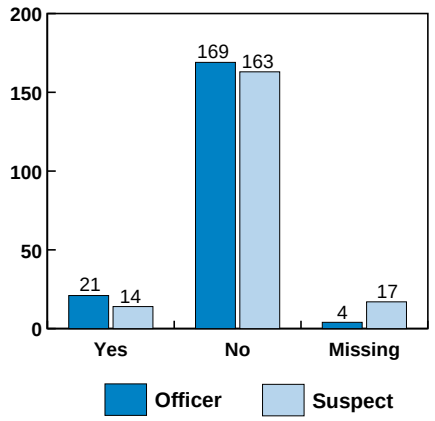
Injuries to officers. Data from the spray collection form showed that few officers were injured when they used OC to control a confrontational encounter. Only 21 officers (11 percent) reported receiving any injury (see exhibit 4). Most of these were minor and resulted in no lost work time. Although data from the pre-OC use period were not comparable and did not permit a

Officers' Comments on OC

The following comments were extracted from the OC data collection sheets completed by the BCoPD officers or from followup interviews:

- Wish we had had it a while ago.
- I think it's a great...alternative to initial use of force.
- Definitely better than using a nightstick.
- The word is out (on the street)...all people have to do is hear the Velcro© and they comply pretty quickly. [The officer who made this comment had actually pulled the OC from his holster at least 10 times, but had sprayed it only once.]
- Some subjects actually apologize after being sprayed.

Exhibit 4: ***Officer/Suspect Injuries***



complete before-and-after analysis, the relatively low level of injuries sustained by officers in the post-OC period suggests that OC use has the potential to reduce officer injuries in confrontational situations.

Injuries to suspects. Very few suspect injuries occurred during the post-OC project period. Of the 174 spray incidents, only 14 suspects (8 percent) received any injuries, and all of these were minor, requiring no hospital treatment (see exhibit 4). Staff were not able to gather pre-OC comparison data; however, it was hypothesized that if suspects were injured, complaints of force would be filed more often. The data collected during the study period indicated that such complaints were decreasing at a rate greater than that observed prior to the introduction of OC. It is reasonable to conclude that OC had a positive effect on reducing the number of suspect injuries.

Use-of-force complaints. Departmental policy states that a use-of-force report must be completed if the subject complains of injury as a result of arrest and goes to the hospital for medical treatment. However, as is true for other less-than-lethal weapons, a use-of-force report is not required for OC, absent a complaint or hospital treatment. BCoPD officials concluded that treating OC differently could inappropriately hinder its use.

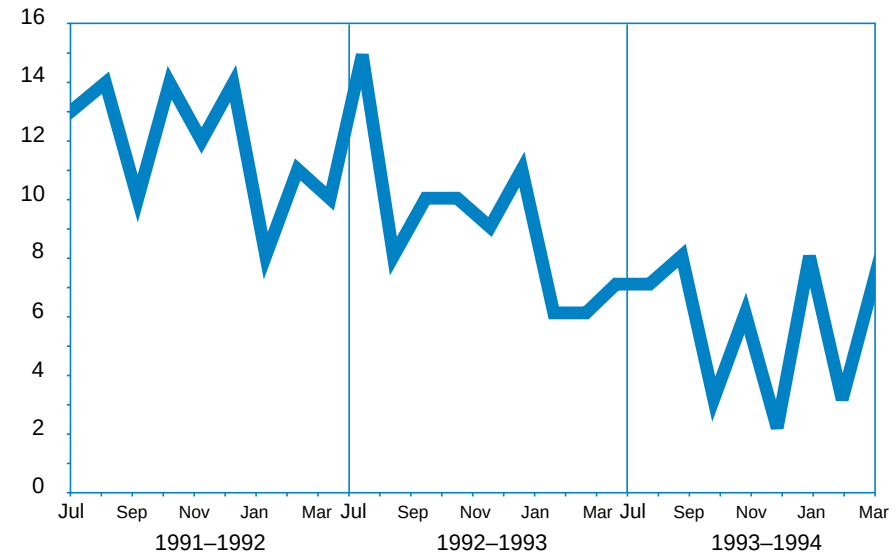
Data suggest that despite an increase in calls for service and fewer patrol officers working their beats, use-of-force complaints declined by 53 percent during the second pre-OC period (July 1991 through March 1992) and the post-OC period. Similarly, a reduction of 40 percent occurred between the third pre-OC period (July 1992 through March 1993) and the post-OC period (see exhibit 5). Since no other major policy changes regarding use of force took place during pre- and post-data collection, it is likely that the use of pepper spray accounted for the decrease in complaints. Interviews with Internal Affairs officers add weight to this finding. These officers noted that, unlike those of impact weapons, the effects of OC are short-lived and nontraumatic; pepper spray thus reduces the likelihood that brutality or excessive force complaints would be lodged. In addition, sprayed individuals received aftercare from the officers who sprayed them, which may have obviated the need to complain.

During the time of data collection (July 1993 through March 1994) and over the span of 174 sprayings, five complaints of brutality and one use-of-force case were received by BCoPD. These complaints centered on the officer's purportedly inappropriate behavior and did not address the spray itself. To date, BCoPD has not had any complaints or suits filed that relate to the issue of OC spray.

Summary

Most police departments in the United States are concerned about officer and suspect safety. In recent years, this concern has focused on injuries to police officers and citizens during arrest confrontations. To meet this problem, departments have sought answers in technology involving less-than-lethal weapons. Aerosol pepper spray is one weapon from the LTL arsenal that effectively addresses the issue of officer/citizen injury.

Exhibit 5: ***Complaints Alleging Force***



This study's findings indicate that BCoPD successfully implemented its OC operation. Statistical measurements of effectiveness were high, and those related to officer assaults, officer and citizen injuries, and use-of-force complaints were low. Study findings showed that OC spray offers advantages over more problematic sprays and that a well-developed OC spray program can provide a variety of operational benefits for law enforcement agencies. In addition, the process followed by BCoPD could guide other police departments interested in OC implementation.

Notes

1. Granfield, John, Jamie Onnen, and Charles S. Petty, M.D., *Pepper Spray and In-Custody Deaths*, Executive Brief, Alexandria, Virginia: International Association of Chiefs of Police, March 1994.

2. The terms "submissive" and "compliant" were used by officers completing the data collection form. An individual officer's understanding and expectation of OC's effect on a suspect may cause him or her to make a distinction between the terms. Officers who believe that the purpose of OC is to totally incapacitate a subject, with no resistance, might describe the suspect as submissive and conclude, therefore, that the product worked. If the OC did not perform as expected, the same officer might report that the product had no effect—despite the fact that the suspect was easier to arrest as a result of being sprayed. Other officers might believe that the product worked well, even though the suspect offered a struggle. This discussion is offered to caution against strict interpretation of subjective responses.

3. More research is required to obtain definitive answers to the question of how intoxication, drug use, and/or mental illness affect a person's reaction to OC spray.

The National Institute of Justice is a component of the Office of Justice Programs, which also includes the Bureau of Justice Assistance, Bureau of Justice Statistics, Office of Juvenile Justice and Delinquency Prevention, and the Office for Victims of Crime.

NCJ 162358

The full report summarized in this Research in Brief was prepared by Steven M. Edwards, John Granfield, and Jamie Onnen under National Institute of Justice grant number 92–IJ–CX–K026. The authors were with the International Association of Chiefs of Police while conducting their evaluation. Questions about the full report may be directed to John Firman, research coordinator, IACP.

U.S. Department of Justice
Office of Justice Programs
National Institute of Justice

Washington, D.C. 20531

Official Business
Penalty for Private Use $300

BULK RATE
POSTAGE & FEES PAID
DOJ/NIJ
Permit No. G–91