

**Report on Electronic Control Weapons (ECWs)
Submitted to the City of Berkeley**

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Introduction

The Stanford Criminal Justice Center (SCJC) serves as a research and policy institute on matters related to the criminal justice system. At the request of the Berkeley City Council, the SCJC produced the following report on Electronic Control Weapons (“ECWs,” for short)¹ as the Council considers whether to launch an ECW pilot program for the Berkeley Police Department (BPD). In accordance with its mission of providing research for the public sector, the SCJC prepared the report as a *pro bono* contribution to this important public debate.

METHODS AND SCOPE

The SCJC report aims to help the City Council evaluate the potential benefits and consequences of equipping city police with ECWs. The Council’s primary concern was the impact of ECW adoption on the safety of police officers and the citizens they protect. The Council also sought information on the acute health effects of ECWs, the legal framework that governs ECW use, and how adoption might impact the city’s budget.

To answer those questions, we have read and analyzed approximately 150 studies on the public safety impacts of ECW adoption, the physical effects of ECWs on the human body, and the legal ramifications of ECW adoption. We have attempted to rigorously assess each of these studies, critiquing their methodologies and assumptions, as well as considering possible critiques of those critiques. Our goal has been to help identify what is and what is not known about ECW as a law enforcement tool, and to separate well founded claims from those with a weak foundation.

The City Council and the SCJC originally planned to survey several nearby jurisdictions in order to examine outcomes following ECW adoption. The goal was to extrapolate from the results of nearby cities, whose demographics and characteristics might be similar to those of Berkeley.

As the Center’s research continued, however, it became clear that a survey of nearby jurisdictions would *not* provide meaningful or accurate answers to the most important questions. Many of those questions had been addressed by a vast body of empirical

¹ ECWs are often informally referred to as “Tasers,” after the trade name of Taser International, a major manufacturer of these devices. This report refers to the devices as Electronic Control Weapons, because we have been asked to report on the technology as a whole, rather than the characteristics of one company’s product. However, it would be impossible to present a complete picture of the impact of ECWs without addressing the role of Taser International, which promotes nationwide adoption of ECWs and funds a large portion of the medical research into their effects. As a result, this report will address the company’s role and impact where appropriate.

research conducted by teams of medical and social scientists, often with the support of grants from the National Institute of Justice (NIJ). The best studies take years to gather, code, and analyze data, which are subject to statistical controls to help account for the characteristics that make each jurisdiction or subject unique. On the question of whether ECWs help reduce injuries to suspect and police officers, for instance, just one of the two leading datasets includes 24,000 use-of-force records from 12 cities, which were chosen from a nationally representative survey of 1,000 municipal, county, and state law enforcement agencies.

In short, attempting to reproduce those inquiries by simply surveying nearby cities would risk capturing information irrelevant to the demographics and dynamics of Berkeley. At the same time, the very familiarity of those nearby cities would make it even easier to draw misleading conclusions. Moreover, for some of the most important questions, even the most sophisticated research had yielded conflicting results.

Ultimately, we determined that the best way to help the Berkeley City Council answer these questions was to effectively synthesize this vast literature into an overview of what is known, while setting aside specious or poorly supported claims. Throughout the course of this research, we have learned that some of the most important questions do not have an answer—in some cases, because research is still ongoing; in other cases, because the answers depend on underlying values and beliefs. We believe that identifying and explaining those questions that do not have clear answers is one of the more useful functions of this report.

WHAT IS NOT COVERED, AND WHY

A PRESCRIPTION FOR BERKELEY

In the conclusion of this report, we present our general impression of the costs and benefits associated with ECWs, based on our view of the literature. After many months of surveying the research, we have come to recognize that *identifying* the impact of ECWs often requires *weighing* the evidence-backed costs and benefits against each other.

At the same time, this report makes no recommendation as to *whether* the Berkeley Police Department should be equipped with ECWs. We were not asked to make such a recommendation for the city—nor could we, because our research has shown the extent to which that decision depends on the values and needs of the city itself. Nor do we make specific recommendations on *how* ECWs should be deployed, if Berkeley were to launch a pilot program. Developing a policy tailored to any city requires study and debate that is beyond the scope of this report, and would be a task for the residents of Berkeley and their elected officials and governmental bodies.

Finally, this report does not formulate general prescriptions or best practices. Such recommendations have been developed by other organizations. The 2011 Electronic Control Weapon Guidelines, developed by the Police Executive Research Forum (PERF) with the support of the Office of Community Oriented Policing Services at the U.S. Department of Justice, are perhaps the most comprehensive set of publicly available guidelines. While we do not endorse those guidelines, we recognize them as a useful resource for understanding “mainstream” policy recommendations on use-of-force, training, and many other important aspects of ECW policy. Where appropriate, we provide footnotes that point to relevant ECW guidelines and other resources, while maintaining our focus on analyzing empirical evidence on the impact of different policy choices.

..... FISCAL IMPACT

This report does not address the financial questions related to the adoption of ECWs. Presenting meaningful information on several important cost categories was infeasible within the scope of this project. We have listed several cost categories below, and have suggested ways in which the city might measure those costs at a later date.

More importantly, we have come to see the question of cost as a matter of secondary concern, compared with issues of public safety. We recognize that it is tremendously important to consider the fiscal impact of any policy choice. However, as explained below, it is not yet clear whether and to what extent ECW deployment improves public health and safety. Whether or not ECW deployment comes at a financial price that a city considers “affordable” is of little consequence until those questions are answered. As a result, we have spent our time investigating these threshold issues.

Moreover, the answers to questions of cost in many ways *depend* on the answers to questions of efficacy and safety that we have focused on. In the future, the City Council might consider cost-benefit analyses that model the upper- and lower-bounded findings on officer and suspect injury rates.

- Some important cost categories to consider in the future include: **Equipment Costs:** A vendor or manufacturer of ECWs is best positioned to provide these figures in the event that Berkeley decides to deploy them.
- **Litigation Costs:** It was not feasible to collect meaningful figures within the scope of the present work. Claims are frequently resolved through confidential settlements, making it difficult to obtain any figures except those awarded in atypical cases that receive media attention. At best, we could only present anecdotal information on settlements and jury awards gleaned from reports in the most egregious cases. This precludes us from offering figures on the potential budgetary impact of litigation in the event that Berkeley decides to adopt ECWs.

- **Workers’ Compensation Costs and Insurance:** Calculating these costs depends largely on the extent to which ECW adoption leads to lower rates of injuries to police officers and/or less serious injuries when officers are injured. A cost-benefit analysis specific to Berkeley would require extensive access to, and consideration of, current expenditures in many areas of the city’s budget.

EXECUTIVE SUMMARY

PART 1: WHAT THEY ARE, AND WHAT THEY DO

THE BASICS

- Electronic Control Weapons (ECWs) have been widely adopted by police officers as “less-lethal” weapons. ECWs are most commonly used in “dart mode,” in which nitrogen canisters propel a pair of barbed electrodes toward a subject. When the electrodes make contact with the person’s body, they complete a circuit and deliver an electrical charge that causes involuntary muscle contractions, as well as significant levels of pain for the duration of the charge.
- ECWs were invented in the 1960s, and the technology developed significantly in the 1990s. ECWs have been broadly adopted by law enforcement agencies in the United States. Although estimates vary, approximately 12,000–15,000 law enforcement agencies equip at least some of their officers with ECWs, at least as of 2011.
- This report presents a survey of empirical literature on issues related to ECW policy. It is important to note that even the best empirical studies are riddled with caveats that limit the confidence readers can place in their results. For example, the medical literature reflects the limits on what researchers can ethically test in a controlled setting, while structural issues make it difficult to gather reliable data about the impact of ECW adoption by police officers. Many important questions are still being investigated.

RELIABILITY

- Researchers have examined how reliably ECWs incapacitate resistant suspects, thus ending an encounter that has or might become dangerous. While the research on ECW reliability is largely jurisdiction-specific, there is support for the claim that ECWs are generally effective at disabling resistant subjects.

HEALTH EFFECTS

- There is no simple way to discuss the medical risks associated with ECWs because there are so many fluid factors to consider. ECWs have distinct impacts

on different segments of the population, and their relative safety also varies with the circumstances of any given interaction.

- Despite these individual- and event-specific factors, researchers have arrived at one broad, caveat-filled conclusion: There is a general consensus that ECWs are safe for use on healthy individuals who are not under the influence of drugs or alcohol, are not pregnant, and do not suffer from mental illness—so long as the individual receives only a standard five-second shock to an approved area of the body.
- Significantly, these conclusions largely stem from medical studies that use healthy male police officers as subjects. As a result, this conclusion has only limited applicability to the population at large. Moreover, there are still several unexplored areas of medical research. Additionally, research suggests that many or most people subjected to ECWs in the field have one or more of the risk factors addressed in the medical literature, i.e., they are under the influence of alcohol or illicit drugs, or have physical or psychiatric comorbidities.

PART 2: HOW AND WHEN ECWS ARE USED

- As is true with any use of force by police officers, ECW use is governed by the Fourth Amendment to the United States Constitution, which requires that officers use reasonable force in relation to the circumstances and magnitude of the threat.
- At a practical level, police officers are guided by departmental use-of-force policies. A legally sound policy represents a distilled version of the Fourth Amendment’s legal framework. Yet use-of-force policies are not identical; they reflect a jurisdiction’s policy decisions about when it is appropriate to use ECWs and other types of force in response to suspect resistance.
- Major nationwide surveys show that police agencies have adopted a variety of approaches to integrating ECWs into their use-of-force policies. Roughly speaking, while some agencies view ECWs “as a first resort,” and a very small number allow ECWs only in situations that would justify deadly force, most agencies fall somewhere in between.
- One common set of guidelines formulated by the Police Executive Research Forum (PERF) recommends that ECWs “should be used only against subjects who are exhibiting active aggression or who are actively resisting in a manner that, in the officer’s judgment, is likely to result in injuries to themselves or others.” They also recommend ECWs should not be used on passive, handcuffed, or fleeing subjects, unless justified by the need to protect suspects, bystanders, or officers.

PART 3: EFFECTS ON PUBLIC SAFETY

READING THE LITERATURE

- Over the past 15 years, researchers have produced a rich, complex, and sometimes conflicting body of literature that investigates the impact of ECW adoption on important policy outcomes related to policing. However, in order to make use of these findings, it is essential to recognize the limitations of the existing literature. While this report surveys the literature and seeks to provide the best-supported conclusions, those limitations often make it difficult to answer important questions with a simple “yes” or “no.”

UNPACKING THE QUESTIONS

- Assessing whether ECW are “effective” requires careful consideration of several different questions. As always, it is important to note that even the best empirical research into those questions suffers from significant limitations.
 - (1) **Do ECWs replace or reduce the use of lethal force (gunfire)?**

There is very little evidence to support this claim. No comprehensive study has considered this question in detail. Studies that address the issue in any fashion suffer from methodological and design limits.
 - (2) **Do ECWs reduce [non-lethal] injuries to officers?**

While the research on officer injuries is by no means unequivocal, there is strong support for the assertion that ECWs reduce injuries to officers to some degree. However, the studies do vary as to the magnitude of the effect, and none have comprehensively addressed reductions to the *severity* of injuries.
 - (3) **Do ECWs reduce [non-lethal] injuries to suspects?**

The answer is that it depends. At first glance, the literature appears to establish a clear relationship between ECWs and reduced injuries to suspects. However, this dominant narrative masks a more complicated body of research that casts doubt on the conclusion. The results of the most reliable studies appear to depend on whether or not the researchers counted punctures from ECW barbs as an injury in their statistical models. This distinction may seem technical or semantic at first. However, we have to come see it as one of the more difficult questions we have examined, because the answers involve subjective judgments about important values that may be in tension with one another. Deciding how to answer this question is an important decision for Berkeley’s policymakers and residents.

(4) Are there alternative practices or tools that would accomplish these goals, such as Crisis Intervention Teams or a focus on de-escalation?

So far, CIT research has mostly focused on changes in attitudes among CIT-trained officers. While the results are encouraging, there is little empirical evidence to support a relationship between CIT training and reduced use of force, or in reduced injuries to officers or suspects.

CONCLUSIONS AND ANALYSIS

The goal of this report was to examine whether empirical research substantiates the perceived benefits and costs of ECWs. We approached the hundreds of studies assessing ECWs hoping to find a body of robust evidence that would support or debunk the many claims—positive and negative—made about these devices. Unfortunately, that was not our experience. Instead, we found that even the best empirical studies in this field are riddled with caveats that limit the confidence readers can place in their results. For every conclusion, there is an asterisk—and often, an asterisk to the asterisk.

While we cannot provide a recommendation specifically for the city of Berkeley, our efforts to *identify* the evidence-backed benefits and costs of ECW adoption have often required us to assess the *weight* of that evidence. Our own conclusion is that, while the literature suggests that ECWs may have benefits, these benefits are easily overstated. Moreover, realizing those potential benefits—such as reducing the rate of injuries to officers and possibly suspects—may require accepting the possibility that vulnerable populations are more likely to be exposed to the painful effects of ECWs. Meanwhile, the “costs,” or potential harms, of using ECWs are not yet fully understood.

We believe this calls for caution in deploying ECWs, and that these devices should be adopted in limited circumstances, if at all. If ECWs are to be adopted, we would urge policy makers to give careful consideration to practices adopted in jurisdictions with long exposure to the benefits and pitfalls of ECWs.

Part 1: What They Are, and What They Do

The following section introduces key background information regarding electronic control weapons. First, we present an overview of the devices and their development. Second, we assess the reliability of ECWs, analyzing their success rate at incapacitating resisting subjects. Finally, we offer an analysis of the health impacts of ECWs, in which we divide the current medical literature into three major groups, highlight the limitations of the literature, and then explain its key findings.

It is important to note at the outset that ECWs have been adopted by many police departments for use as a “less-lethal weapon” (LLW). This designation reflects the reality that ECWs are “*less-lethal*,” not “*non-lethal*.” The same is true of many other common law enforcement weapons, such as batons. Leading police organizations have recognized this distinction by adopting the “less-lethal” terminology. In the words of Philadelphia Police Commissioner Charles Ramsey, “We did a disservice to our men and women ten years ago when we started using this technology and referred to it as ‘less than lethal’ or ‘non-lethal’ force. ‘Less lethal’ is a more accurate term.”²

THE DEVICES THEMSELVES

DEVELOPMENT OF TECHNOLOGY

Less-lethal weapons (LLWs) developed to provide officers with force options less severe than firearms. “In the mid-19th century, police officers in New York and Boston relied on less-lethal weapons, mostly wooden clubs. By the late 1800s, police departments began issuing firearms to officers in response to better-armed criminals.”³ In the late-19th century, officers had two force options of abruptly different magnitudes: wooden clubs and firearms. Because some situations warranted greater force than a wooden club, but less force than a firearm, various LLWs were developed to round out officers’ force options.

Today, police officers utilize a range of LLWs, including electronic control weapons (e.g., Tasers), chemical irritants (e.g., pepper spray, tear gas), and “hard impact” weapons (e.g., batons, flashlights).⁴ Of these, pepper spray and ECWs are the most commonly used LLWs.⁵

² [#1, p. 4.]

³ [#7, p. 4.]

⁴ [#3, p. 13.]

⁵ [#3, p. 13.]

The most prominent brand of ECWs is the Taser, manufactured by Taser International. American nuclear physicist Jack Cover (1920–2009) invented the Taser, naming the device after one of his favorite childhood book characters, Tom Swift.⁶ (“Taser” is an acronym that stands for “Thomas A. Swift Electronic Rifle.”) Cover “began to develop the Taser in the 1960s as a response to a recrudescence of airplane hijackings, with the aim to reduce the risk inherent in the use of firearms to both passengers and airplanes.”⁷

ECWs evolved significantly throughout the late 20th century. Early versions were often bulky and ineffective, but later versions featured increasingly streamlined designs and greater technological sophistication.⁸ New models are battery-powered, and use nitrogen cartridges to fire projectiles.⁹ These models can fire twice before the officer needs to reload the device, in contrast to earlier models, which had to be reloaded once the first cartridge had been expended.

HOW THEY WORK

ECWs can generally be used in one of two ways: “drive stun” mode or “dart” mode.

In drive stun mode, the ECW is held against a subject, which completes a circuit between the device and the person’s body. “In the ‘drive stun’ method, the overwhelming factor is the creation of pain and hence compliance.”¹⁰ Although drive stun has certain technical applications, many police executives recommend against using it as a “pain compliance” tool.¹¹

Dart mode is the method more commonly used by police officers. In this mode, the devices generate 50,000 volts of electricity that is delivered by gas-propelled darts.¹² “Electrodes are fired toward the target as projectiles, [and] neuromuscular stimulation occurs over a larger area. In addition to pain, the device incapacitates the target by stimulating his or her motor nerves and muscles as well as sensory neurons.”¹³

⁶ [#4, p. 179.]

⁷ [#4, p. 179.]

⁸ [#5, p. 704.]

⁹ [#3, p. 14.]

¹⁰ [#15, p. 1451.]

¹¹ See PERF Guideline 16: “Agencies’ policy and training should discourage the use of the drive stun mode as a pain compliance technique. The drive stun mode should be used only to supplement the probe mode to complete the incapacitation circuit, or as a countermeasure to gain separation between officers and the subject so that officers can consider another force option.”

¹² [#7, p. 2.]

¹³ [#15, p. 1451.]

The barbed darts “penetrat[e] the skin most of the time, but the electrical impulses can also be transmitted through clothing.”¹⁴ Once the darts make contact with a subject, they create an electrical circuit, using the subject’s body as a conductor. The electricity travels along thin wires attached to the darts.¹⁵

The charge produced by ECWs stimulates the sensory and motor nerves, causing involuntary neuromuscular contraction.¹⁶ This involuntary muscle contraction temporarily disables subjects, often causing them to fall to the ground.¹⁷ This incapacitation is intended to last for the duration of the electrical discharge. A standard discharge on most Taser models is five seconds, “but [the discharge] can be 15 seconds or longer if pressure on the trigger is maintained.”¹⁸ Tasers are effective at incapacitating targets at a distance of 20 to 35 feet, depending on the model.¹⁹

RELIABILITY

A preliminary empirical question involves the ability of ECWs to incapacitate resisting subjects. One perceived benefit of ECWs is that they allow officers to quickly control and conclude situations that are or might become dangerous. An initial consideration, then, is how effective ECWs are at ending an encounter. The extant research suggests that ECWs are generally effective at disabling subjects. Unfortunately, this body of research is limited in nature, and the existing studies are primarily jurisdiction-specific.

WHITE AND READY (2007)

In “The TASER as a less-lethal force alternative,” Michael White and Justin Ready examined 243 ECW deployment report forms completed by New York Police Department (NYPD) officers between 2002 and 2004.²⁰ NYPD officers who carry ECWs are required to complete these forms every time the device is discharged in the field. The forms include detailed information on officers, suspects, and levels of resistance involved in each force encounter. White and Ready analyzed these forms and found that ECWs incapacitated subjects in 85% of NYPD encounters.²¹ In approximately one-third of the cases reviewed, suspects continued to resist after experiencing the first shock of an

¹⁴ [#4, p. 180.]

¹⁵ [#7, p. 2.]

¹⁶ [#3, p. 4.]

¹⁷ [#8, p. 429.]

¹⁸ [#15, p. 1451.]

¹⁹ [#3, p. 15; #4, p. 180.]

²⁰ [#9.]

²¹ [#9, p. 182.]

ECW.²² The ECW entirely failed to incapacitate suspects in 33 cases, which represents a 14% failure rate.²³

..... WHITE AND READY (2010)

In a 2010 study²⁴ relying largely upon the same dataset as their 2007 work,²⁵ White and Ready identified several factors related to ECW ineffectiveness. The researchers measured ECW ineffectiveness in two ways, using two different dependent variables. First, White and Ready measured “continual resistance,” defined as resistance that continued throughout an encounter even after an ECW discharge.²⁶ An encounter was coded as continual resistance if the ECW *never* subdued the suspect. Second, the authors measured “any resistance,” defined as a situation where the suspect was *initially* subdued by the ECW, but began resisting again later.²⁷

White and Ready identified several predictors of these two forms of ECW ineffectiveness. The researchers found that suspects continued to resist following ECW deployment in situations where: (1) the suspect’s body weight was greater than 200 pounds, (2) the suspect was under the influence of drugs or alcohol, or (3) one or both ECW darts missed the intended target.²⁸

While informative, the 2010 study has some limitations. The authors studied an agency that issues ECWs to only a small percentage of Emergency Service Unit (ESU) officers. Moreover, ESU officers could only use ECWs in specific situations (e.g., to restrain an emotionally disturbed person or someone at risk of injuring himself or others). As White and Ready acknowledge, “[W]e have examined one police department with a restrictive and closely monitored deployment pattern, which limits the conclusions we can draw.”²⁹

..... MESLOH, ET AL. (2008)

Finally, a 2008 study by Charlie Mesloh et al. provides additional support for the claim that ECWs are generally effective at disabling subjects.³⁰ In “Less Lethal Weapon

²² [#9, p. 184.]

²³ [#9, p. 182.]

²⁴ [#10.]

²⁵ The 2010 study relies on the same NYPD data as the 2007 White & Ready study, but examines Taser deployment forms from 2002–2005, for a total of 375 forms (rather than 243 forms reviewed for the 2007 study).

²⁶ [#10, p. 79.]

²⁷ [#10, p. 79–80.]

²⁸ [#10, p. 86.]

²⁹ [#10, p. 97.]

³⁰ [#29.]

Effectiveness,” Mesloh et al. measured the extent to which ECWs effectively conclude officer and suspect confrontations.³¹ Mesloh et al. relied on a smaller dataset, which included use-of-force reports compiled between 2000 and 2005 for two agencies in Central Florida: the Orlando Police Department and the Orange County Sheriff’s Department. The researchers used the data from these use-of-force reports to break individual officer/suspect confrontations down into a series of iterations, each representing a single action and reaction.³² This allowed them to examine whether ECW discharge ended the officer/suspect confrontation, or allowed it to escalate into another iteration.³³

According to Mesloh et al., “As the confrontation continues from iteration to iteration, the likelihood of injury to both officers and suspects rises.” Mesloh et al. coded an ECW discharge as “effective” if the suspect became immediately compliant after a single five-second application.³⁴ Ultimately, Mesloh et al. concluded that ECWs have a 69% success rate.³⁵

HEALTH EFFECTS

It can be challenging to assess the medical risks associated with ECWs because the debate regarding ECW safety is often polarized. Concerned advocacy organizations such as Amnesty International have issued reports claiming up to 334 ECW-proximate deaths between June 2001 and August 2008.³⁶ In an attempt to counteract this claim, leading manufacturers have steadfastly and uncritically affirmed the safety of their devices.

There is no simple way to discuss the medical risks associated with ECWs because there are so many fluid factors involved. ECWs have distinct impacts on different segments of the population, and their relative safety also varies with the circumstances of any given interaction. For example, a healthy, relaxed male will react to an ECW discharge differently than an agitated male under the influence of alcohol. Moreover, even two healthy, relaxed males may react differently to an ECW discharge depending on the duration of the discharge and the location of the barbs. There are simply too many fluid individual and incident-level characteristics to allow for broadly generalizable statements about the health impacts of ECWs.

³¹ [#29, p. 88.]

³² [#29, p. 49.]

³³ [#29, p. 67.]

³⁴ [#29, p. 54.]

³⁵ [#29, p. 88.]

³⁶ [#12.]

Despite these individual- and event-specific factors, researchers have arrived at one, caveat-filled conclusion. There is a general consensus that ECWs are safe for use on healthy individuals who are not under the influence of drugs, alcohol, or mental illness, and are not pregnant, so long as these individuals receive only a standard five-second shock to an approved area of the body.³⁷ Significantly, these conclusions largely stem from medical studies that rely on healthy male police officers as subjects. As a result, this conclusion has only limited applicability to the population at large. Moreover, the individuals most often on the receiving end of ECW discharges are not healthy, sober individuals. Research suggests that the population of individuals who most commonly experience ECW shocks includes people under the influence of drugs or alcohol, or in a state of excited delirium.³⁸

In response to these limitations, researchers have increasingly begun to perform studies that more closely mirror field conditions, where the subjects of ECW shocks are agitated and/or under the influence of an illicit substance. Researchers have also examined how the impact of ECWs varies with the duration of the shock or the location of the ECW barbs. This effort has led to the creation of a very complex body of literature, characterized by a focus on distinct and nuanced research questions. As a result, the first step in grappling with the current medical research is to clearly understand the exact question addressed by researchers, as well as the specific population tested.

FRAMING THE LITERATURE: 3 MAJOR GROUPS

The first key distinction in the current literature is the one between (1) prospective, observational studies on humans, (2) prospective, observational studies on animals, and (3) retrospective human case reviews. Within all three groups, researchers have attempted to address different questions about the medical impact of ECWs, as illustrated in Table I, below:

³⁷ Approved areas of the body most often include all parts of the body *other than* the face, chest area surrounding the heart, and groin.

³⁸ “Excited delirium is one of several terms that describe a syndrome that is broadly characterized by agitation, excitability, paranoia, aggression, great strength and unresponsiveness to pain, and that may be caused by several underlying conditions, frequently associated with combativeness and elevated body temperature.” [#13, p. 21.]

TABLE I: THREE GROUPS OF MEDICAL STUDIES

TYPE OF STUDY	TOPICS EXPLORED
PROSPECTIVE, OBSERVATIONAL HUMAN STUDIES	Effects of ECW on: <ul style="list-style-type: none"> • Heart • Respiratory system • Metabolism • Blood chemistry • Venous pH
PROSPECTIVE, OBSERVATIONAL ANIMAL STUDIES	Effects of ECW on: <ul style="list-style-type: none"> • Heart (including after prolonged, repeated discharges or while under influence of drugs) • Blood chemistry • Impact of dart placement
RETROSPECTIVE HUMAN CASE STUDIES	Effects of ECW on: <ul style="list-style-type: none"> • Pregnancy • Incident characteristics of ECW deployment • Incident characteristics of arrest-related deaths

In prospective human studies, researchers expose human volunteers to ECWs for varying lengths of time. Generally, the researchers follow a standard pattern: first, they record baseline physiologic measurements pre-ECW exposure; next, they expose subjects to ECW discharge; and finally, they record the relevant post-ECW measurements. Prospective human studies have examined many different medical questions, including the cardiac impact of both the M26 and X26 Taser models, as well as the impact of ECWs on respiration, blood chemistry, venous pH, and metabolism. At least one study³⁹ has examined the effects of ECW exposure on legally intoxicated subjects.

Although there have been an impressive number of prospective human studies, these studies suffer from some limitations. First, many studied small sample sizes. Second, these studies often rely on healthy police volunteers who were not under the influence of drugs, alcohol, or excited mental states. Thus, the results of these studies may not be generalizable to the segment of the population most likely to experience the discharge of ECWs.

³⁹ [#14.]

Prospective animal studies comprise the second major body of medical research. In prospective animal studies, researchers have primarily attempted to address issues that would be too dangerous or unethical to explore with human subjects. Like the human studies, these studies generally examine the cardiac impacts of ECWs, but they often do so by subjecting subjects to prolonged or repeated ECW discharges. In contrast to many human studies, which limit ECW discharges to 5–15 seconds, the animal studies often involve longer discharges (up to 40 seconds). The animal studies have also explored the impact of ECW dart placement on the heart, in order to determine if certain barb positions exacerbate harm to the cardiovascular system. Finally, animal studies have examined the impact of ECW exposure on swine subjects injected with cocaine.

Like the prospective, observational human studies, these animal studies also suffer from some noteworthy limitations. Although the animal studies are better able to replicate the field and subject conditions in which ECWs are generally deployed, they suffer from generalizability concerns. Researchers simply do not know to what extent their results, using animal subjects, are applicable to humans.

Retrospective human case studies comprise the third major body of medical research, and they address three main areas of interest. First, these studies have examined the broader, incident-level characteristics of ECW deployment, in order to determine the types of people most commonly subjected to ECW discharge and the circumstances in which this takes place. Retrospective case studies have also examined the incident-level characteristics of arrest-related deaths involving ECWs. Finally, some retrospective case studies address narrow questions, such as the impact of ECWs on pregnant women.

Retrospective human case studies also suffer from some limitations. In contrast to prospective human or animal studies, retrospective human case studies do not occur in a controlled experimental setting. As a result, it is often not possible to control for confounding variables.

LIMITATIONS OF EXISTANT MEDICAL LITERATURE

Assessing the medical literature is complicated not only by its reliance on different subjects and methodologies, but also because so much of the studies are funded by Taser International. “Two groups have performed the majority of human clinical investigations on ECWs to date: Ho [and Dawes], using partial manufacturer funding, and Vilke et al., using U.S. federal funding.”⁴⁰ Doctors Jeffrey Ho and Donald Dawes have published a multitude of studies on the medical impact of ECWs. Dr. Ho is the Medical Director of Taser International, and Dr. Dawes is an expert consultant for Taser International. Both

⁴⁰ [#4.]

men also own shares of stock in the company. Individually and jointly, Doctors Ho and Dawes have published a large proportion of the overall body of literature assessing the medical impacts of ECWs. Although this funding source does not discredit the research or the methodology of an individual study, it should be noted for its possible effect on what is known about the health effects of ECWs. It is also worth noting that Taser International sometimes touts the results of research conducted by company employees or board members without transparently describing the circumstances under which the statistics were produced.⁴¹

In addition to these funding concerns, the medical research is also complicated by the fact that researchers have not reached an agreement on many basic, foundational questions, such as the mechanism by which ECWs incapacitate subjects. “[T]he fact is that our knowledge and understanding of ECW effects is incomplete. Indeed, there is uncertainty about how exactly ECWs achieve their effects on the human body. Some propose that the effects of ECWs are due entirely to electrically induced tetany [muscular spasms], while others hypothesize secondary effects due to nerve stimulation and reflex effects.”⁴²

In short, the current medical research paints anything but a clear picture. The studies explore specific questions using different methodologies and subjects. Many foundational gaps also exist within the literature. As a result, it is difficult for any lay person to reach generalizable conclusions using the current literature. Thankfully, a comprehensive NIJ-sponsored study has synthesized much of the extant literature into a series of concrete, evidence-based recommendations. Conducted by a steering group of expert emergency doctors, cardiac specialists, and medical examiners, this NIJ study provides the most authoritative and reliable overview of the extant medical literature.

THE NIJ STUDY: SEVEN QUESTIONS

The 2011 NIJ study, “Study of Deaths Following Electro Muscular Disruption,” was carefully structured to draw on a range of medical expertise.⁴³ The study was directed by a steering group comprised of representatives from the NIJ, the College of American Pathologists, the Centers for Disease Control and Prevention, and the National Association of Medical Examiners. The steering group appointed a medical panel composed of forensic pathologists, medical examiners, and physicians or specialists in the fields of cardiology, emergency medicine, epidemiology, and toxicology. This

⁴¹ See, e.g., <http://www.nytimes.com/2005/01/14/business/taser-shares-rise-on-news-of-safety-study.html>.

⁴² [#13, p. 21.]

⁴³ [#13.]

medical panel was specifically structured to avoid conflicts of interest. No panelists were chosen who had worked as litigation consultants for or against ECW manufacturers.

The medical panel proceeded in three phases. First, the panel conducted mortality reviews of 300 ECW-related deaths (defined as deaths where an officer deployed an ECW on an individual who later died). The panel focused on reviewing those cases where ECW was listed on the death certificate. Second, the panel reviewed the current state of research regarding the medical effects of ECWs. Specifically, the panel performed an extensive review of the extant research, identifying over 2,500 initial publications and studies. This list was ultimately reduced to 175 peer-reviewed journal articles, which were then reviewed and rated for their scientific quality and relevance.

This process ensured that the panel relied on the most significant and trustworthy studies available as the bases for their conclusions. Finally, the panel consulted stakeholders including experts, human rights groups, law enforcement professionals, physicians, researchers, and manufacturers of ECWs, inviting over 30 experts to make presentations. The NIJ report contains the ultimate findings and recommendations of the medical panel, which we believe represents the most thorough, independent review of the current medical literature.

The medical panel presented its findings in the form of 12 topical headings, which featured a detailed analysis followed by conclusions and recommendations. What follows is a brief overview of those conclusions most relevant to this report. For ease of understanding, we have reframed some of the panel’s topical headings into questions.

..... 1. ARE ECWS SAFE FOR CONTINUED USE BY THOSE LAW ENFORCEMENT AGENCIES THAT USE THEM?

The NIJ panel concluded that law enforcement agencies need not discontinue their use of ECWs, so long as the agencies deploy them in accordance with appropriate use-of-force policies. The panel explains:

“There is no conclusive medical evidence in the current body of research literature that indicates a high risk of serious injury or death to humans from direct or indirect cardiovascular or metabolic effects of short-term ECW exposure in healthy, normal, non-stressed, non-intoxicated people. Field experience with ECW use indicates that short-term exposure is safe in the vast majority of cases.”⁴⁴

⁴⁴ [#13, p. viii (emphasis added).]

The panel noted that many of the ECW-proximate deaths or serious injuries involved repeated or prolonged ECW discharges, and stressed that there has been limited research on humans involving ECW exposures of longer than 15 seconds.⁴⁵

2. WHAT IS THE LIKELIHOOD OF MODERATE OR SEVERE INJURIES CAUSED BY ECWS, INCLUDING DIRECT AND SECONDARY INJURIES?

Before answering this question, the panel defined the terms “moderate injury” and “severe injury.” According to the panel, “moderate injury” is an injury requiring inpatient treatment and/or an injury that is expected to result in no more than a moderate long-term disability. The panel defined “severe injury” as an injury involving a threat to life or inpatient treatment, or one expected to result in severe long-term disability. The panel concluded that the potential for moderate or severe injury from ECWs is generally low. This is true with respect to injuries stemming from direct and indirect (e.g., falls, fractures, etc.) impacts of ECWs.⁴⁶

According to the panel, the direct impacts of ECWs include wounds or burns caused by dart punctures. Additionally, the direct impacts of ECWs may be exacerbated where an ECW dart strikes an unapproved area. For example, ECW punctures to the eyes can lead to a loss of vision, and ECW punctures to the throat can lead to throat perforation.

The panel also emphasized the risk of serious injuries stemming from the indirect effects of ECWs. Examples of indirect effects include ignition risks due to an ECW sparking near flammable materials, or the results of discharging an ECW upon a person standing on a steep slope or a tall structure who falls and receives traumatic injuries, or someone in water who then drowns.⁴⁷ The panel explained, “It is clear that physical injury secondary to dart puncture . . . is a real though relatively uncommon danger.”^{48, 49}

The panel concluded that the total probability of ECWs directly or indirectly causing a moderate or severe injury is less than 1%.

⁴⁵ See PERF Guideline 21: “Personnel should be trained to use an ECW for one standard cycle (five seconds) and then evaluate the situation to determine if subsequent cycles are necessary. Training protocols should emphasize that multiple applications or continuous cycling of an ECW resulting in an exposure longer than 15 seconds (whether continuous or cumulative) may increase the risk of serious injury or death and should be avoided.” [#15, p. 20.]

⁴⁶ [#13.]

⁴⁷ In its “Version 18 User Update,” Taser International notes, “[Neuromuscular incapacitators] frequently causes people to fall to the ground or other surface. They may or may not be able to catch or brace themselves and cushion the fall. Several people have suffered significant injuries including death from falling on a hard surface following an ECD exposure.”

⁴⁸ [#13, p. 23.]

⁴⁹ See PERF Guideline 31: “ECWs should not be used when a subject is in an elevated position where a fall may cause substantial injury or death.” [#15, p. 21.]

3. WHAT RISKS DO ECWS POSE TO THE CARDIOVASCULAR SYSTEM?

The panel discussed three significant irregular heart rhythms: ventricular fibrillation (VF), ventricular capture (VC), and ventricular tachycardia (VT).

The panel concluded that there is no evidence to suggest that ECWs induce irregular heartbeat in humans, so long as they are deployed reasonably. However, the panel also emphasized that ECW use involving the area of the chest directly in front of the heart is not entirely risk-free.

Specifically, the panel concluded that the risk of ECWs *directly* inducing VF is exceedingly low, although the likelihood may be dependent on where the ECW darts are located in relation to the heart. Research on swine has indicated that there is a greater chance of VF when the barb is placed near the heart. The panel also described how some swine studies have found that an extended ECW discharge is capable of inducing VT and that it can sometimes lead to death. As with VF, the risk of VT in swine may be dependent on the barbs' proximity to the heart. Ultimately, the panel concluded that the risk of VT in humans remains low.

The panel also addressed the problem of hypothetical analyses, which play a recurring role in the ECW literature. Specifically, the panel noted that while many of the cardiac concerns surrounding ECWs are theoretically possible, there have not been any demonstrated cases. For example, the use of ECWs on individuals with pacemakers or defibrillators could theoretically be hazardous, although there have been no documented adverse events associated with such use.

Ultimately, the panel concluded that the research simply does not substantiate the claim that there is an increased risk of irregular heartbeat from ECWs. However, the panel does recognize that the use of ECWs in close proximity to the heart is not totally risk-free.⁵⁰

4. WHAT RISKS DO ECWS POSE TO THE RESPIRATORY AND METABOLIC SYSTEMS?

⁵⁰ In its "Version 18 User Update," Taser International provides an illustration of the preferred target zone that exclude the upper chest area. The company writes, "The further an ECD dart is away from the heart, the lower the risk of affecting the heart. The risk of ECD causing cardiac arrest in humans is not zero, but is sufficiently remote that making accurate estimates is very difficult."

As noted in the 2011 PERF Guidelines, before 2009 the company had not instructed law enforcement agents to avoid firing ECWs at a subject's chest. "The new recommendation created confusion in the law enforcement community and heightened concerns about police agencies' liability. Some law enforcement officials have said they do not understand why the bulletin was issued, given the manufacturer's assertion that the weapon, when used properly, is safe. TASER International contends that the change is not a new policy and that the recommendation is based on risk management principles, not medical or safety concerns." [#15, p. 37.]

As the panel explains, the respiratory system and the kidneys maintain the acid/base balance in the human body, responding to the metabolic demands of the individual. Because ECWs induce muscle contractions that naturally produce lactate, it is possible that these weapons could increase the overall amount of lactate in the bloodstream. Additional lactate in the blood increases the overall acidity of the blood, potentially jeopardizing the acid/base balance. In order to compensate for this disproportion, the respiratory rate often increases in turn. In extreme cases, the increase in blood acidity (also known as acidosis) may lead to cardiac arrest.

In order to mitigate these risks, the panel recommended that law enforcement officers refrain from prolonged ECW discharges (i.e., discharges longer than 15 seconds). The panel was particularly concerned with the role that acidosis might play in combination with metabolic abnormalities, drug intoxication, or excited delirium. According to the panel, further study is required to fully understand the interaction between acidosis and individuals in these states.⁵¹

5. WHAT RISKS DO ECWS POSE TO INDIVIDUALS IN A STATE OF EXCITED DELIRIUM?

“Excited delirium [ED] is one of several terms that describe a syndrome that is broadly characterized by agitation, excitability, paranoia, aggression, great strength, and unresponsiveness to pain, and that may be caused by several underlying conditions, frequently associated with combativeness and elevated body temperature.”⁵² According to the panel, the majority of ED cases involve the use of illicit stimulants.

Additionally, it is important to note that drive stun mode may have no impact on individuals in a state of ED, as these individuals are often insensitive to pain (and drive stun mode is a pain compliance mechanism, not a muscular incapacitation mechanism).⁵³

Significantly, no human studies have been performed in situations modeling excited delirium. “Because of this uncertainty, [the panel recommends that] the number and

⁵¹ See PERF Guideline 34: “Personnel should be aware that there is a higher risk of sudden death in subjects under the influence of drugs and/or exhibiting symptoms associated with excited delirium.” [#15, p. 21.]

⁵² [#13, p. 21.]

⁵³ See note on “Risks Associated with ECWs” accompanying PERF Guidelines: “The primary function of the drive stun mode, when not used to complete the circuit [in the event that one of the probes is ineffective or becomes dislodged], is to gain subject compliance through the administration of pain. *Using the ECW to achieve pain compliance may have limited effectiveness and, when used repeatedly, may even exacerbate the situation by inducing rage in the subject.*” [#15, p. 14 (emphasis in original).]

duration of ECW discharges should be generally limited to the minimal amount needed to attain restraint.”⁵⁴

6. ARE ECW'S MORE HARMFUL TO AT-RISK POPULATIONS?

When used according to the manufacturer’s instruction, the literature suggests a substantial safety margin of ECWs in normal healthy adults. However, this does not necessarily mean that the devices are safe for small children, those with diseased hearts, the elderly, pregnant women, or other potentially at-risk individuals. According to the panel, the effects of ECWs on these populations are not clearly understood, and the use of ECWs on these individuals should be minimized or avoided unless there is no other alternative.^{55, 56}

Ultimately, the panel concluded, “All evidence suggests that the use of ECWs carries with it a risk as low as or lower than most alternatives. While it should be remembered that unlikely events may occur, it is unreasonable to demand that any application of force be totally risk-free in all populations at all times.”⁵⁷

7. WHAT IS THE SAFE DURATION FOR ECW DISCHARGE?

Most ECW exposures in the field involve a discharge of 15 seconds or less, and as a result many medical studies employ ECWs on subjects for this length of time. Human studies and animal studies both indicate that there is a low risk of injury from a single Taser X26 discharge lasting less than 15 seconds.

Experiments involving swine subjects indicate that repeated exposures of over 80 to 90 total seconds may be associated with an increased risk of VF and death. However, the risk of prolonged exposure in humans is unknown. The panel explained, “Law enforcement personnel should be aware that . . . most deaths associated with ECW use involved multiple or prolonged discharges.”⁵⁸ Ultimately, the panel recommended that

⁵⁴ [#13, p. 21.]

⁵⁵ In its “Version 18 User Update,” Taser International notes that ECD use has not been scientifically tested on: pregnant women, the infirm, the elderly, small children, or low body-mass index (BMI) persons.

⁵⁶ See PERF Guideline 27: “ECWs should not generally be used against pregnant women, elderly persons, young children, and visibly frail persons. Personnel should evaluate whether the use of the ECW is reasonable, based upon all circumstances, including the subject’s age and physical condition.” [#15, p. 20.]

⁵⁷ [#13, p. 24.]

⁵⁸ [#13, p. 27.]

law enforcement officers minimize or avoid multiple or prolonged activations of ECW as a means to subdue a subject.^{59, 60}

CONCLUSION

It is important to remember that our knowledge regarding the medical safety of ECWs is limited by the current state of medical research, and by ethical limits to experimental design. As the NIJ panel succinctly explained, “[T]he fact is that our knowledge and understanding of ECW effects is incomplete. . . . While such a thorough comprehension may not be necessary to measure the physiologic effects . . . associated with ECW deployment, it means that all recommendations are subject to revision as our understanding improves.”^{61,62}

Despite these limitations, however, there is a general consensus that ECWs are safe for use on healthy individuals who are not effected by drugs, alcohol, or mental illness, and are not pregnant, so long as these individuals receive only a standard five-second shock to an approved area of the body.⁶³

⁵⁹ In its “Version 18 User Update,” Taser International includes a slide titled, “Refresher: A Few Basics.” On this slide, the company writes, “Do not exceed 15-second exposure without justification.” (See Taser Annual Update 18.)

⁶⁰ See PERF Guideline 21, *supra*, note 44.

⁶¹ [#13, p. 45.]

⁶² For example, in January 2014, White et al. published the very first study examining the effects of the TASER on cognitive functioning. [#16.] White et al. concluded that participants “experienced statistically significant reductions in several measures of cognitive functioning following TASER exposure.” [#16, p. 12.] Because White et al. published this study after the NIJ panel completed its work, the NIJ panel did not consider the results of this research.

⁶³ Approved areas of the body most often include all parts of the body *other than* the face, chest area surrounding heart, and groin.

Part 2: How and When ECWs Are Used

Now that we have established how ECWs work and what an individual device does, we will broaden our scope: looking beyond the device and its impact on the body, we will explore *how* the device is actually used by police agencies.

HOW WIDELY ARE THEY USED?

ECWs have been broadly adopted by law enforcement agencies in the United States. Although estimates vary, approximately 12,000–15,000 law enforcement agencies employ ECWs in some fashion, at least as of 2011.⁶⁴ According to the most recent federal survey, there are approximately 18,000 state and local law enforcement agencies in the United States.⁶⁵ Taser International claims that over 18,000 of 18,250 LEAs in the United States currently deploy their devices.⁶⁶ Estimates also vary regarding the total number of ECW units in circulation. One fact, however, is clear: ECWs have been growing in popularity.⁶⁷

Researchers estimate that ECWs have been deployed in more than 660,000 field scenarios, as well as on 880,000 human volunteers.⁶⁸ According to one 2011 study that surveyed 194 LEAs, “In 2009, the number of ECW activations in responding law enforcement agencies ranged from 0 to 473. The ECW activation rate (the number of activations per ECW per year) ranged from 0 to 3.18, with a median activation of 0.25 and a mean of 0.38.”⁶⁹ According to a 2007 study, when ECWs were used in dart mode, officers used a single discharge approximately 50% of the time.⁷⁰

⁶⁴ [#13, p. vii; #7, p. 1.]

⁶⁵ 2008 Bureau of Justice Statistics. <http://www.bjs.gov/index.cfm?ty=dcdetail&iid=249>. Accessed March 9, 2015.

⁶⁶ <https://www.taser.com/press>. Accessed June 14, 2015.

⁶⁷ A 2009 study estimated that over 100,000 Tasers had been issued to LEAs nationwide. [#3, p. 14.] Just two years later, a 2011 study estimated that 260,000 ECWs had been issued to LEAs throughout the United States. [#13, p. vii.] According to Taser International, as of the fourth quarter in 2014, the company has sold approximately 800,000 electrical weapons worldwide (Taser website). According to a 2011 national survey of LEAs, the number of ECWs in agencies that adopted the weapons ranged from a low of two to a high of 4,479. [#15, p. 25.]

⁶⁸ [#4, p. 179; see also #19, p. 1.]

⁶⁹ [#15, p. 25.]

⁷⁰ [#4, p. 180.]

WHO ARE THEY USED UPON?

As described in the medical section, the safety of ECWs depends in large part on individual traits of the recipient. The clearest conclusion to be drawn from the available medical evidence is that ECWs likely do not pose a risk of serious cardiovascular problems in “healthy, normal, non-stressed, non-intoxicated people.”⁷¹ However, research suggests that this “ideal candidate” for safe exposure is rarely found among the population most frequently subjected to ECW shocks.

A comprehensive review published in 2011 found that “more than 90% of the individuals on whom an electronic control device was used in the field were young men, with a mean age of 30 to 32 years,” but “the majority of subjects exposed to a Taser were under the influence of alcohol or illicit drugs or had psychiatric comorbidities.”⁷² People suffering from mental illness are also more likely to be subjected to use of force generally, including deadly force.⁷³

Police leaders acknowledge the broader issue, with regard to ECWs and to use of force in general. The Police Executive Research Forum’s 2011 ECW Guidelines caution that “[p]ersonnel should be aware that there is a higher risk of sudden death in subjects under the influence of drugs and/or exhibiting symptoms associated with excited delirium.”⁷⁴ PERF has also conducted research and issued reports on “avoiding the unnecessary use of force against persons with mental illness . . . or other issues that can cause them to behave erratically.”⁷⁵ Many departments, including Berkeley’s, have attempted to address the issue by adopting the Crisis Intervention Team approach (discussed further in Part 3, below).

WHEN MAY POLICE USE THEM?

LEGAL STANDARDS

The debate around electronic control weapons presents many novel policy questions—yet in key ways, the adoption of ECWs would not require Berkeley to consider major new legal issues. What follows is a brief description of the way that ECWs fit into the constitutional framework governing police use of force, a body of law that already guides the operations of the BPD.

⁷¹ [#13, p. viii.]

⁷² [#4, p. 180.]

⁷³ [#1.]

⁷⁴ [#15, p. 21; see also “Health Effects” in Part 1, *supra*.]

⁷⁵ [#14, p. i.]

The use of force by police officers is governed by the Fourth Amendment to the United States Constitution, which provides that “[t]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated.”⁷⁶ Police use of force, including use of an ECW, is considered a “seizure of the person,” and thus force must be “reasonable” to comply with the Fourth Amendment.

In the 1989 case *Graham v. Connor*, the U.S. Supreme Court developed the analytical test that courts⁷⁷ use to determine whether police have violated a person’s Fourth Amendment rights through an unreasonable seizure. When a person sues the police alleging that a particular use of force was unlawful, the court must consider whether the actions were “objectively reasonable” in light of the circumstances known to police officers at the time.⁷⁸ To put it simply, the court must “balance the amount of force applied against the need for that force.”⁷⁹

There are few universal rules for when the use of force is reasonable. Instead, the law recognizes that the balancing test “is always a very fact-specific inquiry,”⁸⁰ because interactions between citizens and police involve many variables that could tip the scales one way or another.

The U.S. Supreme Court has never ruled on a case that specifically addresses when it is reasonable for police to employ ECWs. Therefore the controlling law stems from cases decided by federal appeals courts, the highest federal courts below the Supreme Court. The U.S. Court of Appeals for the Ninth Circuit, which interprets federal law as applied in California and other Western states, has decided several important cases on the use of ECWs. Those cases establish the broad contours of when the use of an ECW is “reasonable” under the Fourth Amendment.

For more detail, see Appendix B, which includes a table of important Ninth Circuit ECW cases. The table lists factors that courts consider in weighing the legitimate need for the use of ECWs against the seriousness of the intrusion on an individual’s Fourth Amendment interests.

⁷⁶ U.S. Constitution, Amendment IV (ellipses omitted).

⁷⁷ Depending on the circumstances, an excessive force lawsuit might be decided either by a judge or by a jury. For the sake of simplicity, we will refer to “courts” deciding legal issues, rather than trying to account for both possibilities and specifying “judge” or “jury.” (Important procedural issues determine whether a judge decides a case before it reaches a jury, but these issues go beyond the scope of this report.)

⁷⁸ *Graham v. Connor*, 490 U.S. 386, 397 (1989).

⁷⁹ *Meredith v. Erath*, 342 F.3d 1057, 1061 (9th Cir. 2003).

⁸⁰ *Gravelet-Blondin v. Shelton*, 728 F.3d 1086 (9th Cir. 2013).

DART MODE

The use of ECW in dart mode constitutes an “intermediate or medium, though not insignificant, quantum of force.”⁸¹ The law recognizes that ECWs cause “immobilization, disorientation, loss of balance, and weakness,” inflicting pain that “is intense, is felt throughout the body, and is administered by effectively commandeering the victim’s muscles and nerves.”⁸² The court has also recognized a risk of serious injury should “intense pain and loss of muscle control cause a sudden and uncontrolled fall.”⁸³

Depending on the circumstances, the law may treat dart mode as more intrusive than other modes of “less-lethal” force, like pepper spray or heavy impact weapons, because an ECW in dart mode “intrudes upon the victim’s physiological functions and physical integrity in a way that other non-lethal uses of force do not.” At the same time, the law “recognize[s] the important role controlled electric devices . . . can play in law enforcement . . . [when] justified by the governmental interest involved.”⁸⁴

DRIVE STUN MODE

The Ninth Circuit has not specifically described what level of force is involved when an ECW is used in drive stun mode. However, an important Ninth Circuit case suggests that drive stun mode constitutes a lower, but still significant, use of force.⁸⁵

USE-OF-FORCE POLICIES

Many law enforcement agencies, including the Berkeley Police Department, employ written use-of-force policies that specify when it is appropriate for officers to use a given level of force. Policies are often based on a “continuum,” a guideline that officers can use to determine the type of force that may be used in generic situations. The guidelines are sometimes linked to specific levels of citizen resistance, in an attempt to help an officer match the level of force she employs to the threat she encounters.⁸⁶

A legally sound use-of-force policy represents a distilled version of the Fourth Amendment framework for reasonable use of force. (For instance, a policy suggesting that officers may use deadly force in response to impolite language would not be constitutionally “reasonable.”) At the same time, use-of-force policies are not identical;

⁸¹ See *Bryan v. MacPherson*, 630 F.3d 805, 825 (9th Cir. 2010) (citations and quotation marks omitted).

⁸² *Id.*

⁸³ *Id.*

⁸⁴ *Id.* at 826.

⁸⁵ *Mattos v. Agarano*, 661 F.3d 433, 451 (9th Cir. 2011) (citations and quotation marks omitted).

⁸⁶ [#33, p. 15–16.]

different configurations may provide officers with significantly more or less discretion in their use of force, so long as the policy stays within the flexible boundaries of “reasonableness.” Policies also vary in terms of how the guidelines are expressed—some are purely verbal, while others employ matrices or visual metaphors, such as ladders, stairs, or wheels.⁸⁷

PERF’s 2011 Guidelines include broad recommendations on how ECWs should be placed in a departmental use-of-force policy.⁸⁸ Although specific recommendations regarding use-of-force integration are beyond the scope of this report, empirical research offer some perspective on where ECWs often fall within departmental use-of-force policies.

Two major national studies have surveyed police agencies to determine whether they employ a use-of-force continuum, and if so, where various tactics and weapons are placed upon that continuum. Smith et al. found that 88% of agencies surveyed use some type of force continuum in policy or training.⁸⁹ Terrill and Paoline (2012) found over 80% of the respondents indicated that they rely on some type of force continuum.^{90, 91}

These studies also gathered detailed responses on when respondent agencies authorize different levels of force, including ECWs. Some agencies view ECWs “as a first resort,” whereas others encourage ECW use just prior to deadly force.⁹² Most agencies, however, will fall somewhere in between. The findings of these two leading studies are presented below. Unfortunately, as with so many aspects of the ECW literature, it is difficult to directly compare the findings as a result of differences in methodology.

..... TERRILL AND PAOLINE (2012)

As part of a multi-year, NIJ-funded study of use-of-force policies, researchers William Terrill and Eugene Paoline sent surveys to a random sample of over 1,000 police and

⁸⁷ [#33, p. 16.]

⁸⁸ PERF Guidelines #25, #27, and #29 recommend that ECWs “should be used only against subjects who are exhibiting active aggression or who are actively resisting in a manner that, in the officer’s judgment, is likely to result in injuries to themselves or others.” ECWs should not be used on passive, handcuffed, or fleeing subjects, unless justified by the need to protect suspects, bystanders, or officers.

⁸⁹ [#21, p. 3-5, 3-7.]

⁹⁰ [#33, p. 16.]

⁹¹ Terrill and Paoline’s study also sought to determine whether particular force policy designs lead to “more beneficial outcomes for police practitioners.” These outcomes included: (a) providing officers assistance and guidance in making use-of-force decisions (as determined by officers’ own perceptions), and (b) reductions in the rates of injuries (to suspects and officers), citizen complaints, and lawsuits levied for improper force. The results of their analysis fall beyond the scope of our report, but interested readers should consult their full findings. [See #33.]

⁹² [#18, p. 39.]

sheriff’s departments. They received responses from 662 agencies that represent a range of sizes; half of the responses came from agencies with between 50–250 sworn officers.⁹³

Terrill and Paoline reported that placing ECWs within the force continuum offered “the greatest challenge” for police administrators. Roughly a quarter of the surveyed agencies placed ECWs at the same level as “hard empty-hand” tactics (e.g., punches). Another 13% of the agencies placed ECWs alongside “pain compliance techniques,” such as pressure-point controls and joint locks. Nearly 60% of the agencies placed ECWs at or close to the level of “impact weapons,” including batons. Just 2% placed ECWs at the level of deadly force.⁹⁴ Table II illustrates these summary findings, along with explanations of the force-categories that Terrill and Paoline used to analyze their data.⁹⁵

TABLE II: SUMMARY OF TERRILL AND PAOLINE FINDINGS ON ECW PLACEMENT⁹⁶

	ECWS PLACED WITH	. . . WHICH INCLUDES
2%	“Deadly Force”	Handguns, rifles
60%	“Impact Weapons”	Batons, flashlight strikes, pepper-balls, beanbag guns
25%	“Hard Empty Hand”	Hand strikes, punches, kicks, take-downs
13%	“Pain Compliance “	Pressure-point controls, joint locks
0%	“Physical Soft”	Touching, pat-downs, firm grip, simple restraint
0%	“Presence / Verbal”	

..... **SMITH ET AL. (2010)**

Smith et. al worked with the Police Executive Research Forum to survey a sample of 1,000 police agencies on their use-of-force policies and outcomes. They received

⁹³ [#33, p.15.]

⁹⁴ [#33, p. ii.]

⁹⁵ Table II is not meant to reflect the way that agencies rank force categories *relative* to one another; obviously, deadly force will always rank highest. One of the purposes of Terrill and Paoline’s study was to document the *many variations* in how agencies position these categories, as detailed in their full study report. Table II places the categories in this arbitrarily chosen order for the sake of clarity only.

⁹⁶ [#33, p. ii.]

responses from 518 agencies, and weighted the responses based on the size and location of the agencies, aiming to present a composite picture of law enforcement nationwide.⁹⁷

To account for the fact that agency policies often categorize levels of force or resistance differently, their survey used several different approaches to collecting data on the placement of ECWs within the force continuum.

First, the survey asked agencies to consider several hypothetical questions, and to report what type of force would be authorized in response under their policy. The questions were essentially variations on the same basic scenario: a traffic stop for a minor moving violation during daytime hours, in which the suspect and the police officer are matched in size and build.⁹⁸ Answers to these “scenario questions” showed that:

- Roughly one quarter of the agencies authorize the use of ECWs to overcome “passive resistance,” such as when a suspect sits down and refuses to comply with police commands.⁹⁹
- When confronted with “defensive resistance”—the most frequent type of resistance encountered by officers—60% of the agencies allow the use of an ECW. (In the survey’s “defensive resistance” scenario, the suspect “tenses and pulls away” when the officer attempts to handcuff him.)
- Once the suspect’s resistance level becomes threatening, 70% of agencies surveyed allow the use of an ECW.¹⁰⁰

The survey also asked respondents to determine whether ECWs are placed above, below, or at the same level as nine other types of force. These “ranking” questions tried to account for agencies’ different methods of grouping force in two ways: First, the respondents were asked to rank ten types of force on a scale of “1” to “highest,” rather than using a specific number for the upper boundary (because, for instance, one agency’s policy might recognize three “levels” of force, while another might recognize five). Additionally, the agencies were allowed to indicate the same number for multiple types of force if those tactics were grouped at the same level in the use-of-force continuum.¹⁰¹

Table II below illustrates how the ten types of force are “ranked” based on an average of the responses from the 518 agencies that returned the survey. Agencies that employed

⁹⁷ [#21, p. 3-5.]

⁹⁸ [#21, p. 3-9.]

⁹⁹ Notably, this represents a divergence from the 2011 PERF Guidelines.

¹⁰⁰ [#21, p. 8-5.]

¹⁰¹ [#21, p. 3-21.]

ECWs generally place ECWs at the same level as chemical agents, such as pepper spray, in their force continuum. Agencies vary as to the placement of ECWs relative to strikes or punches, but ECWs are generally placed lower on the continuum than impact weapons.¹⁰²

TABLE III: SMITH ET AL. SURVEY ON FORCE RANKING¹⁰³

TYPE OF FORCE	AVG. FORCE SCORE
Firearms	5.5 ("Highest" Level)
Kinetic weapons or munitions (e.g., beanbag projectile)	4.4
Incapacitation holds (e.g., neck restraints)	4.4
Batons /impact weapons	4.1
Chemical / kinetic hybrids (e.g., pepper filled projectiles)	4.0
Strikes / punches	3.3
ECWs	3.1
Chemical sprays (e.g., pepper spray)	2.6
Control holds (e.g., escort, pain-compliance holds)	2.1
Verbal commands	1.0 (Lowest Level of Force)

CONCLUSION

Use-of-force policies reflect the decisions of police officers and elected officials, and—ideally—the values of the community itself. If the Berkeley Police Department were to launch an ECW pilot program, the city and its leaders would need to determine how to

¹⁰² [#21, p. 3-26.]

¹⁰³ [#21, p. 3-22.]

integrate ECWs into the department’s current use-of-force policy. Any debate involved in making that decision, however, could be expressed in terms of a familiar constitutional framework.

Part 3: Effects on Public Safety

Proponents of ECWs argue that the devices provide significant public safety benefits. Specifically, advocates assert that ECWs replace the use of lethal force, or reduce injuries to police officers and/or suspects. What follows is an attempt to unpack and address these public safety questions, surveying the extant literature in order to determine whether the empirical evidence supports these claims.

HOW TO READ THE EVIDENCE

UNPACKING THE QUESTION

Assessing whether ECW are “effective” requires careful consideration of several different questions:

- (1) Do ECWs replace use of lethal force (gunfire)?
- (2) Do they reduce [non-lethal] injuries to officers?
- (3) Do they reduce [non-lethal] injuries to suspects?
- (4) Are there alternative practices or tools that would accomplish these goals, other than deploying electronic control weapons (such as Crisis Intervention Teams, or a focus on de-escalation)?

Over the past 15 years, researchers have produced a rich, complex, and sometimes conflicting body of literature to determine the impact of ECW adoption on important policy outcomes related to policing. These studies have become more thorough and more sophisticated with the passage of time. The following section surveys this literature and explains its key findings. However, in order to interpret these findings, it is essential to recognize their underlying limitations.

NOTES ON EXPERIMENTAL DESIGN

The ideal way to answer these questions with evidence-based, scientific precision would be to conduct a randomized controlled trial, the “gold standard” of experimental design used for applications such as pharmaceutical trials. Of course, such an experiment would be impossible. While a medical researcher can recruit people for a study, randomly assign them to a “treatment” and a “control” group, and then compare the results for each group, social scientists cannot conjure up two identical cities, equip one city’s police department

with ECWs, and then compare the public safety outcomes between the two. Thus, the literature on the impact of ECWs includes studies that vary widely in the strength of their experimental design and the quality of the underlying data.

The earliest evidence offered to show the real-world impact of ECW adoption often came from individual departments that published internal statistics from before and after the adoption of ECWs. In the mid-2000s, independent researchers also began to evaluate and publish studies based on data gathered from individual departments. Although the results of single-department studies widely publicized—perhaps contributing to the development of the “conventional wisdom” around ECW effectiveness—their findings are of limited value. These “straightforward ‘before and after’ analyses suffer from threats to internal validity and did not measure the effect of [ECWs] on injury risk controlling for situational factors and other types of force used in conjunction with [ECWs] during any given force incident.”¹⁰⁴

Over time, the research has evolved, as researchers have conducted larger-scale studies that employ more robust designs, such as quasi-experimental comparisons of multiple cities over multiple years. We have focused on these later studies, which present more meaningful conclusions by taking steps to account for the differences between cities. At the very least, studies must control for “aggregate-level” factors (such as the city’s population size and density, crime rate, number of sworn officers per 10,000 residents, racial composition, median household income, percentage of population unemployed, etc.). That information is readily available and crucial if results from different jurisdictions are to be in any way comparable to one another.

The most useful source of data for researchers attempting to answer these questions comes from special reports that officers in some jurisdictions are required to file after an incident in which they have used force. Researchers try to identify jurisdictions where officers are required to complete a standard form that includes crucial information such as the level of force an officer used, what resistance she encountered, and whether the police officer or the suspect sustained an injury. By assigning numerical values to events described in use-of-force reports, researchers can analyze and report on correlations between them.

Ideally, incident reports would also include information that would allow researchers to assess how officers and citizens interact in a given encounter (including the impact of the officer’s level of training and experience, as well as the age, race, and sex of everyone involved). Coding these factors allows researchers to include “incident-level” controls in

¹⁰⁴ [#19.]

their statistical models, which can better account for the true impact of ECWs, while controlling for other factors.

Due to differing policies among police departments—toward use and documentation of force—researchers struggle to find data from which reliable conclusions can be drawn. To a large extent, this is a result of the decentralized nature of law enforcement in the United States. As noted above, there are at least 18,000 state and local law enforcement agencies, which set their own standards regarding how to report force, or whether to make special reports at all.¹⁰⁵ Even the most comprehensive and sophisticated studies are limited by these structural limitations to gathering comparable data.¹⁰⁶

LIMITATIONS OF THE RESEARCH

DUPLICATIVE USE OF DATA

Throughout the ECW literature, the redundant use of key sources can create a false sense of “consensus” around key issues. Because quality data is so hard to come by, researchers may end up publishing multiple papers based on a single dataset. Any flaws, biases, or omissions within a dataset will be reproduced in the resulting papers—yet it is often difficult to determine the precise source of the data being used in a particular paper. Thus, the literature suffers from being both too *specific* and too *general* at the same time. Meanwhile, the sheer volume of studies and the rapid development of the literature can make it difficult to identify valuable sources.

To dispel that confusion, it may help to distinguish between “datasets” and “papers.” Throughout this report, we refer to the results of a researcher’s survey—whether small or large—as a “dataset.” Because of the difficulty and expense involved in collecting useful data, researchers have conducted a relatively small number of investigations whose scope will yield a dataset that can support a meaningful conclusion. These studies are frequently funded through government grants; simply collecting the data can take teams of researchers many years. Readers will also encounter smaller, less reliable datasets, which have deficiencies that will be explained below.

¹⁰⁵ In the United Kingdom, which began deploying ECWs in 2009, the government tracks and publishes comprehensive statistics on Taser use. Every incident in which Taser is deployed – whether it is fired or not – is recorded by the local police force. The report is sent to the Home Office, which collects data that “provide information as to Taser’s operational effectiveness [and] its medical implications, and makes transparent the levels and types of use by the police.” See <https://www.gov.uk/government/collections/use-of-taser-statistics>.

¹⁰⁶ See, for example, self-assessed limitations in the work of Terrill and Paoline [#33, p. 219–225] and Smith et al. [#21, p. 5-4].

Once researchers have access to a dataset, they will analyze it in various ways and present their conclusions, ideally through publication in a peer-reviewed journal. Throughout this report, we will refer to such publications and their conclusions—as a “paper.” A “paper” analyzes and draws conclusions from the information in a particular “dataset.” There are far more “papers” than there are “datasets.” A paper might be written by the same researchers who gathered the underlying dataset, or it might be written by someone who performed an original analysis of a dataset gathered by someone else.

The distinction matters because, as readers or policymakers, we cannot simply read papers for their claimed findings; we must consider the paper’s analytical methods *and* the quality of the underlying dataset. Decision-makers must assign appropriate weight to papers based on credible methodology and data, while discounting those of weaker design. Toward that end, we have paid careful attention to the quality of available datasets, and the ways they might affect the strength of a paper’s conclusions.

..... ROLE OF TASER INTERNATIONAL

Another source of confusion stems from the fact that the scientific and social science debate about ECW efficacy takes place within close earshot of Taser International’s marketing efforts. Readers looking for empirical data should be aware of this. As of June 2015, for instance, Taser International’s website claims that “TASER devices have saved more than 148,000 lives from death or serious personal injuries,” and that “approximately 5% of all TASER deployments save a life or prevent serious bodily injury.”¹⁰⁷ For the source of those claims, the site links to a 2009 “Field Statistics Overview” co-authored by James Brewer, a paid consultant, and Mark Kroll, a member of the company’s corporate and medical advisory board.¹⁰⁸ The “Field Statistics Overview” cites early, single-department studies, and a vaguely defined “broad search for reports relating [ECW] introduction to officer and suspect injuries.”¹⁰⁹ The Taser co-authors admit there are “several limitations to this analysis,” because “[t]he data were self-reported (often without independent quality control) and covered varying deployment years.”¹¹⁰

WHAT DOES THE LITERATURE SAY?

¹⁰⁷ See “Press Room,” <https://www.taser.com/press/stats>. Accessed May 15, 2015.

¹⁰⁸ “Chapter 24: Field Statistics Overview,” James Brewer and Mark Kroll (2009), https://www.taser.com/images/promotions-and-campaigns/taser-products-save-lives/times_police_used_ecds/downloads/taser_life_saving_field_statistics_brewer_study_2009.pdf. Accessed June 15, 2015.

¹⁰⁹ *Id.* at 287.

¹¹⁰ *Id.* at 289.

Now that we understand the complexity—what do the studies actually say, and how trustworthy are their findings?

(1) DO ECWS REPLACE USE OF LETHAL FORCE?

Although there is some support for the contention that ECWs replace and reduce the use of lethal force by police officers, the existing literature cannot strongly support that conclusion. No comprehensive study has addressed this specific question. Moreover, the studies that do address the question suffer from methodological concerns.

What follows is an overview of two main bodies of research: the first supports the claim that ECWs replace the use of lethal force, and the second rebuts this conclusion. Ultimately, we present the one takeaway most researchers agree on: More research needs to be conducted before any conclusions can confidently be drawn.

STUDIES SUGGESTING ECWS DO REDUCE LETHAL FORCE

The strongest support for the claim that ECWs reduce lethal force comes from a study by Frank Ferdik et al.¹¹¹ Ferdik relied on a major national dataset compiled by Smith et al.¹¹² to identify 259 municipal police departments and full-service county sheriff's offices that deployed ECWs as of 2005. Ferdik's aim was to understand whether use-of-force policies governing ECWs are associated with fatal police shootings of citizens.¹¹³ First, Ferdik found that more restrictive ECW policies were associated with *fewer* ECW deployments and, conversely, that less restrictive ECW policies were associated with *increased* ECW deployments.¹¹⁴ These findings would suggest that ECW policies directly influence the frequency with which ECWs are employed—the stricter the regulations, the less often a police officer will choose to use his or her ECW.

More significantly, Ferdik found that permissive policies toward use of ECWs were negatively associated with fatal shootings. Use-of-force policies that allowed officers to use ECWs only on actively resistant suspects (e.g., suspects who are tensing or pulling away) were significantly associated with *increases* in the number of fatal police shootings.¹¹⁵ Conversely, policies allowing the use of ECWs on passive resisters were significantly associated with *decreases* in the number of fatal police shootings.¹¹⁶ “Thus, only the least restrictive ECW policy appear[ed] to be associated with reductions in fatal shootings.”¹¹⁷

¹¹¹ [#20.]

¹¹² [#21.]

¹¹³ [#21, p. 329.]

¹¹⁴ [#21, p. 347.]

¹¹⁵ [#21, p. 348.]

¹¹⁶ [#21, p. 348.]

¹¹⁷ [#21, p. 349.]

A critical limit of Ferdik’s study is that it is an observational, cross-sectional study. This means that the study was aimed at describing features and characteristics of a single moment in time. As Ferdik himself acknowledges, this limits the ability to make any causal inferences.¹¹⁸ At most, his research can be said to suggest some relationship between extremely permissive ECW policies and decreased police shootings. It is important to note that such a policy would also lead to a larger number of people being subjected to ECW shock, and in broader range of circumstances, than a more restrictive policy.

Two jurisdiction-specific studies provide modest support for the contention that ECWs reduce the use of lethal force.

- First, in “TASER and Less Lethal Weapons: An Exploratory Analysis of Deployments and Effectiveness,”¹¹⁹ Charlie Mesloh and Steven Houglund reviewed 400 use-of-force reports from the Orange County Sheriff’s Office (OCSO) between 2001 and 2003. Within those 400 reports, OCSO officers opted to deploy ECWs in all situations where deadly force would have otherwise been justified.^{120, 121} Mesloh and Houglund concluded that “[r]egardless of the intention, it is clear that a substantial number of suspects’ lives were spared as a result of the TASER deployments.”¹²²
- Second, Eastman et al. (2008) devised a jurisdiction-specific study in “Conductive Electrical Devices: A Prospective, Population-Based Study of the Medical Safety of Law Enforcement Use.”¹²³ The researchers conducted a prospective study of 426 ECW field deployments by the Dallas Police Department between November 2004 and January 2006. The researchers ultimately identified 23 encounters where lethal force could have been justified, but officers opted to discharge an ECW instead.¹²⁴

¹¹⁸ “It is possible, for instance, that agencies experiencing high numbers of lethal police shootings will tend to adopt less restrictive ECW policies. This limitation speaks to a critical need for research that takes into account temporal order, such as panel models, interrupted time series, and other quasi-experimental designs to examine how variation in the structure and implementation of use-of-force policies impacts fatal police shootings and related outcomes” [#20, p. 352.]

¹¹⁹ [#22.]

¹²⁰ [#22, p. 72.]

¹²¹ In “Use of Force, Civil Litigation, and the Taser: One Agency’s Experience,” an additional publication referencing the “Taser and Less Lethal Weapons” study, Mesloh and Houglund specify that 18 ECW deployments by members of the OCSO in 2003 “took place when suspect resistance merited the use of deadly force.” [#23, p. 28.]

¹²² [#22, p. 72–73.]

¹²³ [#24.]

¹²⁴ [#24, p. 1570.]

Finally, three non-jurisdictionally specific studies support the claim that ECWs reduce the use of lethal force, relying on different methodologies and underlying populations.

- First, in “The Impact of TASERs on Police Use-Of-Force Decisions: Findings from a Randomized Field-Training Experiment,” William Sousa et al. (2010) devised a field experiment whereby officers were randomly equipped with ECWs. The officers then participated in training scenarios involving different levels of suspect resistance.¹²⁵ Sousa et al. concluded that officers carrying ECWs are less likely to use lethal force than those not equipped with ECWs.¹²⁶
- Second, in “Impact of Conducted Electrical Weapons in a Mentally Ill Population: A Brief Report,”¹²⁷ Jeffrey Ho et al. analyzed law enforcement data voluntarily reported to Taser International.¹²⁸ Ho et al. specifically assessed ECW deployment against mentally ill subjects. The researchers concluded that 45% of ECW deployment against mentally ill subjects occurred in situations where lethal force would have been justified, or where the subject represented an imminent life threat to himself.¹²⁹
- Third, in “Conducted Energy Device Use in Municipal Policing,”¹³⁰ Kyle Thomas et al. provide questionable and unsubstantiated support for the claim that ECWs reduce the use of lethal force. In this national study, researchers surveyed 210 municipal police agencies using a questionnaire. The questionnaire asked agencies about their reasons for adopting ECWs, as well as their experiences using ECWs. According to the researchers, 56% of agencies reported that ECWs reduced the use of lethal force. However, this result represents only the subjective estimates of the respondents.

Thomas et al.’s questionnaire asked: “In your opinion, has the use of ECWs reduced the instances of use of lethal force by your officers over the last 12 months?”¹³¹ The respondents were then instructed to check the “yes” or “no” box.

¹²⁵ [#25, p. 35.]

¹²⁶ [#25, p. 35.]

¹²⁷ [#26.]

¹²⁸ Dr. Ho is the Medical Director of Taser International, and co-author Dr. Donald Dawes is an expert consultant for Taser International. Both men also own shares of stock in the company. Additionally, co-authors Mark Johnson and Erik Lundin work in the Division of Medical and Technical research for Taser International.

¹²⁹ [#26, p. 780.]

¹³⁰ [#27.]

¹³¹ [#27, p. 309.]

The questionnaire then asked, “If Yes, by about what percentage would you estimate it has declined?”¹³² Respondents were then provided with a blank space to fill in their estimates. Significantly, the questionnaire did not require any substantiation or documentation for these purely subjective estimates regarding the use of lethal force. As a result, Thomas et al.’s study only supports the conclusion that many agencies with ECWs *subjectively perceive* that ECWs reduced the use of lethal force.

STUDIES SUGGESTING ECWS DO NOT REDUCE LETHAL FORCE

The strongest support for the claim that ECWs do not reduce the frequency of lethal force comes from “Comparing Safety Outcomes in Police Use-Of-Force Cases,” a PERF-sponsored report.¹³³ There, the PERF research team employed a quasi-experimental method, comparing seven cities that employed ECWs with six cities that did not. The researchers compiled four years of data for all 13 cities, and compared pre-ECW and post-ECW data for the seven cities that employed ECWs. Significantly, the researchers controlled for particularly robust selection of variables in their analysis. The researchers controlled for variations in population demographics across cities, and also controlled for incident-level variations within any given force encounter. Ultimately, the PERF researchers concluded, “On balance, our data suggest that ECWs do not appear to have much of an effect on officer use of firearms in force incidents.”¹³⁴

Three jurisdiction-specific studies are also worthy of brief note.

- First, in “Relation of Taser (Electrical Stun Gun) Deployment to Increase in In-Custody Sudden Deaths,” Lee et al. (2009) assessed 50 California police and sheriff’s departments that deployed ECWs.¹³⁵ Lee concluded that ECWs were not associated with a decrease in firearm-related deaths.¹³⁶
- Second, in “A Force to be Reckoned With: Taser Policies of 20 Arizona Law Enforcement Agencies,”¹³⁷ the ACLU of Arizona reviewed ECW data from 20 Arizona police departments between December 2008 and January 2010. The ACLU concluded that equipping officers with ECWs does not lower the frequency of lethal force.¹³⁸ Specifically, “the information provided by

¹³² [#27, p. 309.]

¹³³ [#3.]

¹³⁴ [#3, p. 41.]

¹³⁵ [#28.]

¹³⁶ [#28, p. 877.]

¹³⁷ [#29.]

¹³⁸ [#29, p. 17.]

departments . . . suggests that Tasers have been deployed in situations where lethal force would *not* be allowed, and where less severe uses of force are available.”¹³⁹

- Finally, in “Electronic Control Devices and Use Of Force Outcomes,”¹⁴⁰ Yu-Sheng Lin and Tonisha Jones examined over 1,000 use-of-force reports from the Washington State Patrol (WSP) between 2005 and 2007. The WSP equipped officers with ECWs in 2006, and Lin and Jones sought to explore their impact on the WSP’s use-of-force practices. Lin and Jones found that “when examining which use-of-force methods were replaced once ECW[s] were officially adopted as a use-of-force method by the WSP, it was found that only the non-lethal force method categories were replaced by ECW.”¹⁴¹ The authors concluded “[t]he adoption of ECD by the WSP did not result in the dramatic reduction of frequency of use of lethal force hoped for from the decision to adopt the universal equipping of WSP troopers with ECD.”¹⁴²

It is important to note that Lin and Jones’ findings may be limited by the fact that their underlying dataset stems from a project funded by the National Highway Traffic Safety Administration. As a result, the data consists primarily of force incidents connected to traffic stops. Traffic stops may be an atypical source of force incidents for certain law enforcement agencies.

CONCLUSION: SCANT EVIDENCE EXISTS THAT ECWS REDUCE LETHAL FORCE, AND MORE RESEARCH IS NEEDED

With regard to whether ECWs reduce the frequency of lethal force, researchers agree on only one point: More research is needed in this area. Even the strongest proponents of ECWs have conceded as much. For example, while Ferdik hypothesizes that the early use of an ECW in a force encounter likely prevents the need to use deadly force, he notes that “the relative paucity of research on this topic and the equivocal findings produced to date warrant additional investigation.”¹⁴³

Geoffrey Alpert and Roger Dunham perhaps put it best, explaining: “The argument that is made by law enforcement is that most if not all of the participants who died when shocked by an ECW would have died if the officers had controlled and arrested them in a

¹³⁹ [#29, p. 17 (emphasis added).]

¹⁴⁰ [#30.]

¹⁴¹ [#30, p. 171.]

¹⁴² [#30, p. 171.]

¹⁴³ [#20, p. 335.]

more traditional hands-on fight, or used deadly force. At this point, the argument is rhetorical, and research is needed[.]”¹⁴⁴

(2) DO ECWS REDUCE INJURIES TO OFFICERS?

One of the frequently touted benefits of electronic control weapons is that they reduce injuries to police officers. ECWs are thought to reduce injuries by allowing officers to incapacitate subjects without the need to apply any physical force, a common source of injury for police officers.¹⁴⁵ By allowing the officer to subdue a suspect from a distance of perhaps 20 feet away, ECWs are thought to help officers avoid some degree of physical danger.

While the research on officer injuries is by no means unequivocal, there is significant support for the contention that ECWs reduce injuries to officers to some degree. What follows is an overview of the research that suggests ECWs reduce officer injuries, followed by an overview of research that questions that premise. Significantly, no research suggests that ECWs *increase* injuries to police officers. However, the studies do vary regarding whether, and the extent to which, ECWs reduce officer injuries.

FINDING: ECWS REDUCE INJURIES TO OFFICERS

Three major national studies support the view that ECW adoption reduces the risk of injury to officers.

PAOLINE ET AL.

In “Police Use Of Force and Officer Injuries,” Eugene Paoline et al. assessed the independent effect of ECWs on officer injuries.¹⁴⁶ Paoline et al. measured the effects of ECWs when used alone or in conjunction with other forms of force. Relying on the dataset gathered during their multi-year, NIJ-funded study,¹⁴⁷ Paoline et al. reviewed 12,000 use-of-force reports gathered from six law enforcement agencies. Paoline et al. employed a multivariate model with a very robust series of controls. The authors controlled for variation at both the aggregate level (e.g., demographic differences) and the incident level (e.g., levels of suspect resistance) in order to better isolate the

¹⁴⁴ [#19, p. 254.]

¹⁴⁵ See, e.g. #31 at p. 2272 (“[W]e found that the use of physical force by police increased the odds of injury to suspects and officers”), and #32 at p. 128 (“Thus, all else being equal, if an officer is trying to decide whether to use an ECW or go hands-on, our findings show there is a benefit to using an ECW (at least in terms of officer injury) so long as no other force is being used along with the ECW”).

¹⁴⁶ [#32.]

¹⁴⁷ [#33.]

independent effect of ECWs.¹⁴⁸ The authors measured officer injuries in three different use-of-force situations: Situations where no ECW was employed, situations where only ECWs were employed, and situations where ECWs were employed along with another type of force.¹⁴⁹

Paoline et al. reached three main conclusions. First, the risk of officer injury decreased when officers used an ECW and no other type of force, as compared to instances where no ECW was used.¹⁵⁰ Second, “when ECW-only cases were compared directly to cases involving hands-only tactics, [there was] a reduced likelihood of officer injury.”¹⁵¹ Finally, where officers used an ECW *in combination* with some other type of force, the risk of officer injury *increased*.¹⁵² The researchers note that most injuries in this category occurred where ECWs were used in combination with hands-only tactics.¹⁵³ The authors’ results are summarized in Table IV:

TABLE IV: PAOLINE ET AL. CONCLUSIONS REGARDING OFFICER INJURY

COMPARISON	IMPACT ON OFFICER INJURY
ECW-only v. No ECW	Decreased
ECW-only v. Hands-only	Decreased
ECW + Other Force v. Other Weapon (baton, pepper spray)	Increased

SMITH ET AL. (2010) PART VI

The second major national study is Part VI of “A Multi-Method Evaluation of Police Use of Force,”¹⁵⁴ conducted by Smith et al. In Part VI, the authors examined over 8,000 use-of-force reports from Austin, Texas and Orlando, Florida. The researchers employed a quasi-experimental approach, comparing data for the sites both pre- and post-ECW deployment.¹⁵⁵ The authors found that officer injury rates in the post-ECW deployment

¹⁴⁸ [#32, p. 123.]

¹⁴⁹ [#32, p. 123.]

¹⁵⁰ [#32, p. 128.]

¹⁵¹ [#32, p. 128.]

¹⁵² [#32, p. 128.]

¹⁵³ [#32, p. 130.]

¹⁵⁴ [#21.]

¹⁵⁵ [#21, p. 6-1.] It is important to note that the Austin Police Department (APD) data suffers from some limitations. While some APD use-of-force reports involved a lone officer and a lone suspect, others

period were lower than would be expected from the pre-ECW period.¹⁵⁶ The authors concluded that ECWs decrease injuries to officers.¹⁵⁷

PERF (2009)

The PERF-sponsored study discussed earlier, “Comparing Safety Outcomes in Police Use-Of-Force Cases,”¹⁵⁸ provides the third major set of findings on this topic. There, the research team employed a multivariate, quasi-experimental model. The researchers selected 13 cities using a matching analysis, and divided the group so that they could compare seven law enforcement agencies (LEAs) that had adopted ECWs to six LEAs that had not adopted ECWs. Within the LEAs that deployed ECWs, researchers collected two years of data *pre*-ECW adoption and two years of data *post*-ECW adoption. Within the LEAs that did not have ECWs, researchers collected at least four years of data. Additionally, the researchers controlled for a variety of incident- and aggregate-level factors over the four-year examination period.

The PERF study concluded that ECWs were associated with large reductions in the frequency of non-severe injuries to officers (e.g., abrasions, burns, or punctures). The research team found no difference between ECW and non-ECW sites with respect to the frequency of severe injuries to officers (e.g., broken bones).

Ultimately, all three national studies concluded that ECWs reduce injuries to officers. Notably, the three studies employed distinct methodologies to reach that result. Much of the criticism surrounding the validity of ECW research stems from claims of flawed or improper methodology. As a result, it is significant that three major studies with different methods and datasets nevertheless concluded that the devices reduce injuries to officers.

involved multiple officers or suspects. In this latter category, the APD often created multiple records for the same single incident. Researchers were unable to identify whether some use-of-force reports involved the same underlying incident. Additionally, the APD phased in ECWs slowly, and researchers thus had to – arbitrarily – select July 2003 as the “intervention point” even though there was substantial ECW deployment in the APD prior to this intervention date.

¹⁵⁶ [#21, p. 6-8.]

¹⁵⁷ [#21, p. 6-8.]

¹⁵⁸ [#3.]

FINDING: ECWS DO NOT REDUCE INJURIES TO OFFICERS

MACDONALD, ET AL. (2009)

One major study explicitly found no relationship between ECW use and officer injury, but it suffers from significant data problems. In “The Effect of Less-Lethal Weapons on Injuries in Police Use-Of-Force Events,”¹⁵⁹ MacDonald et al. analyzed 24,000 use-of-force reports from 12 police departments that documented injuries to officers and citizens. The researchers relied upon the Smith et al. national dataset.^{160, 161} The authors employed a multivariate analysis to determine whether the use of less-lethal weapons—including both ECWs and pepper spray—reduced injuries to officers and suspects. Ultimately, the researchers found no relationship between ECW use and officer injury.¹⁶²

However, this study is limited by the fact that the use-of-force reports from the 12 agencies “varied widely both in terms of their quality and the number of variables available for analysis.”¹⁶³ While the data collected was useful for other issues examined by the larger study, the authors acknowledge that the limitations were “much more problematic for the proposed multiagency analysis.”¹⁶⁴ Thus, although the MacDonald et al. study questions the relationship between ECWs and officer injuries, it lends only limited support to the proposition that no relationship exists.

SMITH ET AL. (2010) PART VI

A subsequent section of Smith et al.’s “Multi-Method Evaluation”¹⁶⁵ provides modest support for the claim that ECWs have no impact on officer injuries. In Part IV of that study, the authors examined use-of-force reports from three LEAs that use ECWs: the Miami-Dade Police Department (MDPD), the Seattle Police Department (SPD), and the Richland County Sheriff’s Department (RCSD).¹⁶⁶ The authors concluded that in both

¹⁵⁹ [#31.]

¹⁶⁰ [#21.]

¹⁶¹ The MacDonald et al. study [#31] was also published as Section V of the Smith et al. study, “A Multi-Method Evaluation of Police Use of Force.” [#21.] MacDonald et al.’s 2009 publication explicitly notes that additional details regarding the study are available in “A Multi-Method Evaluation.” [#21.] As a result, the following analysis relies on information published in both MacDonald et al. (2009) [#31] and Smith et al. [#21].

¹⁶² [#31, p. 2270.]

¹⁶³ [#21, p. 5-4.]

¹⁶⁴ [#21, p. 5-4.]

¹⁶⁵ [#21.]

¹⁶⁶ In “The Impact of Conducted Energy Devices and Other Types of Force and Resistance on Officer and Suspect Injuries,” [#34], Smith et al. reproduce essentially the same findings as Section IV of “Multi-Method Evaluation,” but exclude the SPD from the analysis. It is not clear why Smith et al. chose to exclude SPD from the analysis in “The Impact of Conducted Energy Devices.” However, it is important

the SPD and the RCSD, ECW use had no statistically significant impact on officer injuries.¹⁶⁷ ECWs were only associated with a decrease in officer injuries at the MDPD.¹⁶⁸

The authors hypothesized that these differences were causally related to the fact that RCSD and SPD officers had the option to use pepper spray, while MDPD officers did not.¹⁶⁹ The RCSD had a long history of pepper spray use, in contrast to its relatively recent adoption of ECWs. As a result, RCSD officers might have employed pepper spray more frequently than ECWs, thus limiting the impact of ECWs on officer injuries. No evidence was offered to support this hypothesis.

Section IV of the Smith et al. study suffers from some significant limitations. First, although the dependent variables remained consistent across the three locations, the independent variables differed greatly as a result of variation in the detail and quality of use-of-force reports. Moreover, although the authors acknowledged the stark demographic differences between the three locations (e.g., differences in size of population served, number of sworn officers, and racial composition of the population), they did not employ aggregate-level controls to account for these differences. Indeed, in their attempt to justify their conclusions, Smith et al. suggest that if the three sites “had a similar history with the same less-lethal weapons options, [perhaps] the findings would have been more comparable”.¹⁷⁰ In reviewing Smith et al.’s findings from this section, it is important to keep these limitations in mind.

(3) DO ECWS REDUCE NON-LETHAL INJURIES TO SUSPECTS?

At first glance, the literature appears to clearly establish a relationship between ECWs and reduced injuries to suspects. Many researchers have found such a correlation, and their work has in some ways been accepted as conventional wisdom.¹⁷¹ However, this dominant narrative masks a more complicated body of research that casts doubt on the conclusion.

In order to accurately assess the impact of ECWs on suspect injuries, one must first clearly define the term “injury.” As explained below, researchers have taken many

to recognize throughout the ECW literature that there are many redundancies, and that these redundancies can create a false sense of “consensus.”

¹⁶⁷ [#21, p. 4-18.]

¹⁶⁸ [#21, p. 4-18.]

¹⁶⁹ [#21, p. 4-18.]

¹⁷⁰ [#21, p. 4-19.]

¹⁷¹ See, e.g., *Interim Report of the President’s Task Force on 21st Century Policing* (March 2015), p. 38 (“Studies of [ECWs] have shown them to be effective at reducing both officer and civilian injuries”).

different approaches to defining this term. Because of this variation, it is difficult to draw broad conclusions across studies.

The most significant distinction is one of specificity. Some researchers assess general rates of suspect injury, broadly defined to include anything from a laceration to a contusion. When these researchers refer to rates of “suspect injuries,” they are referring to *any* ECW-related injury to a suspect. In contrast, a second group of researchers approaches the same question with a greater degree of specificity. This group of researchers divides “suspect injuries” into different levels of severity (e.g., minor, moderate, and major injuries). It is important to recognize when a study is referring to the general rate at which suspect injuries *occur*, as opposed to rates of injury organized by *severity*.

There is no simple “yes” or “no” answer to the question of whether ECWs reduce injuries to suspects. The existing research provides guidance only to the extent that one agrees with a researcher’s underlying definitions. As explained more fully below, within the “injury occurrence” analyses, researchers disagree as to which ECW-related impacts are worth counting as “injuries.” Do scrapes count as injuries? Do cuts or bruises from ECW barbs count? Similarly, within the analyses measuring injury severity, there is disagreement regarding where to place certain injuries on the spectrum of severity.

What follows is an attempt to unpack the question of suspect injury more fully. In doing so, we hope to illustrate how the answer to the question turns primarily on choices about what should be counted as an injury. The discussion might seem technical, but the difference is more than just semantic, for it may well determine the answer to one of the most important questions about ECWs and public safety.

We begin with the research regarding general rates of suspect injuries, followed by an overview of the research that analyzes injury severity.

GROUP 1: STUDIES MEASURING OCCURENCE OF SUSPECT INJURY

When assessing how ECWs impact suspect injuries, many studies do not account for variations in injury severity. In these generalized analyses, the key inquiry is not whether an injury should be classified as minor or major, but rather whether a particular harm should be counted as an “injury” at all.

TWO LARGE STUDIES AND ONE SMALLER STUDY SUGGEST THAT ECWS REDUCE SUSPECT INJURIES

In “The Effect of Less-Lethal Weapons on Injuries in Police Use-Of-Force Events”¹⁷² — a study discussed above—MacDonald et al. examined use-of-force reports across 12 police departments. The researchers relied on the Smith et al. dataset.¹⁷³ Employing a multivariate analysis, MacDonald et al. concluded that physical force increases the odds of injury to suspects, while the use of less-lethal weapons (such as pepper spray or ECWs) decreases the odds of suspect injury.¹⁷⁴

The second large study is “Comparing Safety Outcomes in Police Use-Of-Force Cases,” the PERF-sponsored study (also discussed above in the section on officer safety).¹⁷⁵ In this study, PERF researchers employed a quasi-experimental model, matching seven LEAs with ECWs to six LEAs without ECWs. The researchers concluded: “Our results, across all of our analyses, demonstrate that ECWs are related to reductions in suspect injuries.”¹⁷⁶

One smaller dataset provides further support for the claim that ECWs reduce injuries to suspects, but this dataset examines only three agencies. In Section IV of Smith et al.’s “Multi-Method Evaluation,” also discussed above, the researchers examined use-of-force reports from three LEAs that deploy ECWs: Miami-Dade Police Department (MDPD), Seattle Police Department (SPD), and Richland County Sheriff’s Department (RCSD). At the MDPD and SPD, ECWs were associated with a decrease in suspect injuries. In contrast, ECWs had a statistically insignificant impact on suspect injuries at the RCSD.

A RECENT MAJOR STUDY CHALLENGES THE VIEW THAT ECWS REDUCE OCCURRENCE OF SUSPECT INJURIES

In “Conducted Energy Devices and Citizen Injuries: The Shocking Empirical Reality,”¹⁷⁷ William Terrill and Eugene Paoline examined 14,000 use-of-force reports provided by seven different LEAs. The researchers relied on their dataset from their multi-year national study, “Assessing Police Use of Force Policy and Outcomes.”¹⁷⁸ In “Shocking

¹⁷² [#31.]

¹⁷³ The MacDonald et al. study [#31] was also published as Section V of the broader Smith et al. study, “Multi-Method Evaluations” [#21]. MacDonald et al. explicitly note that details regarding their study are available in Section V of the Smith et al. study. As a result of this overlap, the following analysis relies on information published in both #31 and #21.

¹⁷⁴ [#31, p. 2272.]

¹⁷⁵ [#3.]

¹⁷⁶ [#3, p. 62.]

¹⁷⁷ [#35.]

¹⁷⁸ [#33.]

Empirical Reality,” Terrill and Paoline selected seven LEAs for analysis because of their key demographic similarities (e.g., similarities in crime rates, number of sworn officers, and other socioeconomic indicators).¹⁷⁹

Terrill and Paoline designed a sophisticated series of multivariate models in order to assess the impact of ECWs on suspect injuries when used alone or in combination with other types of force.¹⁸⁰ According to the researchers, “The importance of these variable splits should not be understated as they allow us to address one of the primary deficiencies of past studies—isolating and teasing out the influence of ECWs on citizen injuries.”¹⁸¹ Finally, Terrill and Paoline employed a robust series of control measures.¹⁸²

Terrill and Paoline concluded that ECW use, whether on its own or in combination with other forms of force, *increased* injuries to suspects.¹⁸³ “The only time we found a *decreased* probability associated with the use of ECWs was when we compared them to impact weapons; and the only time we found a *similar* injury risk was when comparing ECWs to hard-hand tactics,” such as striking a suspect.¹⁸⁴

ACCOUNTING FOR THE DIFFERENCE

How can we explain these conflicting results? How did Terrill and Paoline conclude that ECWs *increase* suspect injuries, while most other researchers concluded that ECWs *decrease* injuries to suspects?

Terrill and Paoline acknowledge that their results differ from those in the MacDonald et al. (2009) and PERF (2009) studies, which also involved large sample sizes and comparisons of multiple agencies that employ ECWs.¹⁸⁵ Terrill and Paoline suggest that their findings differ because of the way in which they define “suspect injury.”¹⁸⁶

¹⁷⁹ [#35, p. 160.]

¹⁸⁰ Terrill and Paoline’s primary dependent variable was a dichotomous “yes/no” measurement of “any citizen injury.” [#35, p. 162.] The independent variable was “type of force,” which was broken down into a “weaponless tactics” category (e.g. grips, hand controls, etc.) as well as a “weapon-based tactics” category (e.g. ECWs, OC spray, munitions, dogs, and firearms). [#35, p. 163.] These categories were then split into three primary dichotomized variables (ECW only, ECW with other force, and no ECW), which were broken down further still. [#35, p. 163.]

¹⁸¹ [#35, p. 164.]

¹⁸² [#35, p. 164–65.]

¹⁸³ [#35, p. 171–72.]

¹⁸⁴ [#35, p. 176.]

¹⁸⁵ [#35, p. 178.]

¹⁸⁶ [#35, p. 178.]

Critically, Terrill and Paoline note that the MacDonald et al. and PERF studies do not classify lacerations from ECW barbs, or burns and abrasions from an ECW in drive stun mode, as falling within the definition of “suspect injuries.”¹⁸⁷ In fact, both MacDonald et al. and PERF explicitly refused to classify these events as injuries—even where officers had originally opted to classify them as injuries in their use-of-force reports. As the PERF study explained,

“[S]ome LEAs counted skin irritation from pepper spray and ECW dart punctures as injuries. However, this is inconsistent with how we operationalized injuries from these devices in this study . . . details in the narratives allowed us to recode these cases. (ECW dart wounds to *unapproved* targets, such as the groin or face, were counted as injuries, however.) Unfortunately, this recoding could not be done in all datasets, due to the lack of data in some narratives regarding injuries.”¹⁸⁸

Terrill and Paoline suggest that these definitional differences regarding what constitutes a “suspect injury” account for their conclusion that ECWs increase injuries to suspects.

Kaminski et al. responded to Terrill and Paoline’s critique in a later study, “A Quantum of Force: The Consequences of Measuring Routine Conducted Energy Device Punctures as Injuries.”^{189, 190} There, Kaminski et al. examined 2,500 use-of-force reports from a large West Coast LEA throughout 2005.¹⁹¹ Their aim was to create a model that would test the validity of Terrill and Paoline’s hypothesis. To do so, Kaminski et al. created a dichotomous measurement (“injury” or “no injury”) using two different models. The first model *excluded* ECW punctures from the “injury” category.¹⁹² The second model *included* all ECW puncture wounds in the “injury” category (just as Terrill and Paoline had.)¹⁹³ Additionally, Kaminski et al. isolated the independent impact of ECWs by incorporating three different measurements of ECWs (no ECW, ECW only, and ECW plus other form of force).

¹⁸⁷ [#35, p. 178.]

¹⁸⁸ [See #3, p. 28; see also MacDonald et al, #31, p. 2273 (“When the type and cause of injury were available, we coded minor barb punctures and skin irritation as non-injuries so as not to confound the injury analysis. Had we been able to identify and remove all such cases, the observed reductions in injury rates might have been greater.”).]

¹⁸⁹ [#36.]

¹⁹⁰ Kaminski was also co-author in the MacDonald et al. (2009) study.

¹⁹¹ The underlying data comes from one of the 12 agencies in Section V of the Smith et al. study. [#21.]

¹⁹² [#36, p. 10.] The researchers excluded only those ECW punctures that occurred in an approved target area. Where an ECW puncture occurred in an *unapproved* target area—such as the head, face, or groin—the researchers included the puncture as an “injury.”

¹⁹³ [#36, p. 10.]

Kaminski et al. confirmed Terrill and Paoline’s speculation that the inclusion of barb punctures as “injuries” alters the ultimate result.¹⁹⁴ According to Kaminski et al., when barb punctures are *excluded* from the category of “injuries,” ECWs are associated with reductions in suspect injuries, or have no impact on suspect injury rates.¹⁹⁵ In contrast, when barb punctures are *included* in the category of “injuries,” ECWs consistently increase suspect injury rates.¹⁹⁶

Kaminski et al. present a series of policy arguments regarding why puncture wounds from ECW barbs should not be counted as injuries.¹⁹⁷ It is worth noting, however, that in a 2010 case the Ninth Circuit Court of Appeals defined injuries in a manner more consistent with the approach adopted by Terrill and Paoline:

There is an obvious and critical distinction between concluding . . . that Tasers cause ‘mild’ (rather than ‘serious’ or ‘fatal’) injuries on the one hand and suggesting that Tasers cause no injuries on the other. Most of the ‘mild’ injuries described in [one study cited by the dissenting opinion] ‘were superficial puncture wounds’ from the Taser darts, but the fact that puncture wounds through the skin are classified as ‘superficial’ rather than as ‘serious’ or ‘life-threatening’ does not mean that such wounds are insignificant. In fact, such ‘superficial’ barbed dart injuries have the potential to be quite significant.¹⁹⁸

GROUP 2: STUDIES MEASURING SEVERITY OF SUSPECT INJURIES

A second major body of research examines the impact of ECWs on suspect injuries by measuring the *severity* of suspect injury, as opposed to the broad question of whether or not ECWs reduce the *occurrence* of suspect injuries, which was addressed in the Group 1 studies above.

Three major studies address the impact of ECWs on the severity of suspect injury. By examining the injury question with greater precision, the Group 2 studies provide important context in assessing the comparative benefits and drawbacks of ECWs. However, it is difficult to reach clear conclusions regarding the impact of ECWs on injury severity because researchers have defined injury categories in so many different ways. As a result of these differences, the studies produce results difficult to compare.

¹⁹⁴ [#36, p. 18.]

¹⁹⁵ [#36, p. 14–15.]

¹⁹⁶ [#36, p. 14–15.]

¹⁹⁷ [#36, p. 18.]

¹⁹⁸ *Bryan v. MacPherson*, 630 F.3d 805, 813–14 (9th Cir. 2010) (citations omitted).

Broad conclusions are thus not possible, and each study must be understood in the context of its own definitional nuances.

PERF (2009)

In “Comparing Safety Outcomes in Police Use-Of-Force Cases”¹⁹⁹—a PERF-sponsored study discussed above—researchers analyzed suspect injury severity using a series of dichotomous variables, ranging from the least serious injury to the most serious. First, the PERF study examined “suspect injury,” measured as a dichotomous “yes”/“no” variable for *any* impairment or pain a suspect feels due to an officer’s actions. Next, the PERF study measured “suspect injury severity,” a dichotomous variable (“minor”/ “severe”) that separates “minor” injuries (including bruises, lacerations, burns, and punctures) and “severe” injuries (including broken bones, stab wounds, and gun wounds).

The PERF study also examined “suspect injury requiring medical attention,” a dichotomous “yes”/“no” variable indicating whether the suspect was seen by any medical professional (whether on the scene or in a hospital). The study also measured “suspect injury requiring hospitalization,” another dichotomous “yes”/“no” variable indicating whether the suspect was taken to a medical facility for treatment (although not necessarily admitted). Finally, the PERF study measured “suspect death” using a dichotomous “yes”/“no” variable. A summary of PERF’s severity measures is shown in Table V:

TABLE V: SEVERITY MEASUREMENTS USED IN PERF STUDY

INJURY MEASUREMENT	BINARY CODED VARIABLES
Suspect injury – any impairment (broadly defined)	“Yes” or “No”
Suspect injury severity	“Minor” – bruises, lacerations, burns, punctures “Severe” – broken bones, stab wounds, gun wounds
Suspect injury requiring medical attention	“Yes” or “No”
Suspect injury requiring hospitalization	“Yes” or “No”
Suspect death	“Yes” or “No”

¹⁹⁹ [#3.]

The PERF study ultimately concluded that ECWs are associated with a reduction in severe suspect injuries, a reduction in suspect injuries requiring medical attention, and a reduction in suspect injuries requiring hospitalization. The researchers concluded that ECWs have no impact on the number of suspect deaths, although they admit that their results may not be generalizable due to a small and underpowered sample size (44 total suspect deaths).

TERRILL AND PAOLINE (2012)

In the Terrill and Paoline study previously discussed, “Conducted Energy Devices and Citizen Injuries: The Shocking Empirical Reality,”²⁰⁰ Terrill and Paoline also examined suspect injury severity. In addition to their examination of how ECWs impact the occurrence of suspect injuries, the researchers conducted a secondary analysis that incorporated two ordinal dependent variables. The first dependent variable was “injury type,” which was coded into four levels: no injury (zero), bruises/abrasions (minor), lacerations (moderate), and broken bones (major).²⁰¹ The second dependent variable was “hospitalization,” which was coded into three levels: no injury, injury but no transport to hospital, and injury with transport to hospital.²⁰² The study variables are illustrated in Table VI:

TABLE VI: SEVERITY MEASUREMENTS IN TERRILL & PAOLINE STUDY

INJURY MEASUREMENT	CODED VARIABLES
Injury type	Zero (no injury) Minor (bruises or abrasions) Moderate (lacerations) Severe (broken bones)
Hospitalization	No injury Injury but no hospital Injury + transport to hospital

Terrill and Paoline note the challenges of measuring injury severity, as there is always debate regarding where to place each type of injury on the severity spectrum.

²⁰⁰ [#35.]

²⁰¹ [#35, p. 162.]

²⁰² [#35, p. 162.]

As the authors explained,

[W]e conservatively placed lacerations in the moderate category, given the potential for blood being drawn, and hence more serious than bruises. However, one could also argue that not all lacerations are the same (e.g., a small cut being less serious than a 20-stitch wound), although we were unable to make this distinction in the data. Taking it one step further, one may argue that a broken finger is less serious than a deep bone bruise or a 20-stitch laceration. Hence, given the potential variability in constructing our first measure, we incorporate a second ordinal dependent variable involving hospitalization.²⁰³

Terrill and Paoline ultimately concluded that the severity of suspect injuries *increases* when ECWs are used on their own, *or* in combination with other forms of force.²⁰⁴ The only time ECWs *decrease* the likelihood of serious injury is when they are compared to impact weapons.²⁰⁵

KAMINSKY, ET AL. (2013)

Finally, in a previously discussed Kaminski et al. study, “A Quantum of Force: The Consequences of Measuring Routine Conducted Energy Device Punctures as Injuries,”²⁰⁶ Kaminski et al. assessed how the inclusion or exclusion of barb punctures impacted the *severity* of suspect injuries.²⁰⁷ There, Kaminski et al. measured “injury severity” as a dependent variable, coded as “no injury,” “minor injury,” or “major injury.” Kaminski et al. then altered the placement of barb punctures within these categories to reflect Terrill and Paoline’s preferred placement on the severity index, as well as their own.

In the model preferred by Kaminski et al., the variables are defined as follows: no injury (barb punctures to approved targets), minor injury (bruises, sprains, scrapes, soft tissue damages), and major injury (fractures, lacerations, dog bites, concussions, gunshot wounds, or puncture wounds to unapproved targets). In the model preferred by Terrill and Paoline, the variables are defined as follows: no injury, minor injury (*barb wounds to approved targets*, bruises, sprains, scrapes, soft tissue damages), and major injury (fractures, lacerations, dog bites, concussions, gunshot wounds, or puncture wounds to unapproved targets).

²⁰³ [#35, p. 162.]

²⁰⁴ [#35, p. 175.]

²⁰⁵ [#35, p. 176.]

²⁰⁶ [#36.]

²⁰⁷ [#36.]

The authors concluded that “counting ECW [barb] punctures does not change the rate of major injuries, but does increase the minor injury rate . . . and decreases the no injury category.”²⁰⁸ These definitions are summarized in Table VII:

TABLE VII: COMPARING INJURY VARIABLES IN KAMINSKI ET AL. TO TERRILL & PAOLINE

INJURY SEVERITY MEASUREMENT	CODED VARIABLES
Kaminski et al. Approach	No injury – <i>*dart puncture wounds to “approved targets.”</i> Minor injury – bruises, scrapes, sprains. Major injury – fractures, lacerations, gunshot wounds, puncture wounds to unapproved targets
Terrill & Paoline Approach	No injury Minor injury – <i>*dart puncture wounds to approved targets,</i> bruises, scrapes, sprains. Major injury – fractures, lacerations, gunshot wounds, puncture wounds to unapproved targets

* This represents the key difference between the Kaminski approach and the Terrill and Paoline approach.

Ultimately, Kaminski et al. concluded that when barb punctures are counted as “minor injuries,” ECWs *increase* the odds of minor injuries, but do not impact the odds of major injuries.²⁰⁹ When barb punctures are excluded from the injury category (i.e., they are coded as “no injury”), ECWs *reduce* the odds of both major and minor injuries, or have benign effects.²¹⁰

The results of the three major “injury severity” studies, along with their severity definitions, are presented below in Table VIII:




TABLE VIII: SUMMARY OF INJURY SEVERITY DEFINITIONS

AUTHOR	INJURY SEVERITY DEFINED	CONCLUSION
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²⁰⁸ [#36, p. 10–11.]

²⁰⁹ [#36, p. 17.]

²¹⁰ [#36, p. 17.]

PERF	Minor – bruises, lacerations, burns, barb punctures Severe – broken bones, stab wounds, gun wounds	 ECWs <u>reduce</u> severity of suspect injuries
Terrill and Paoline	No injury Minor – bruises/abrasions (includes some barb punctures) Moderate – lacerations (includes some barb punctures) Severe – broken bones	 ECWs <u>increase</u> severity of suspect injuries
Kaminski et al.	No injury – barb punctures to approved targets Minor injury – bruises, scrapes, sprains Major injury – fractures, lacerations, gunshot wounds, barb punctures to unapproved targets	 ECWs <u>reduce</u> severity of suspect injuries

..... **CONCLUSION**

Determining how ECWs impact the rates at which citizens are injured during encounters with police is perhaps one of the most difficult questions that we have examined. In part, that is because of the many difficulties in collecting adequate data, which we have described above. The real difficulty, however, stems from the fact that analyzing the impact of ECWs on the rate or severity of suspects’ injuries depends on how one defines the term “injury.” This, in turn, involves normative value judgments that have no clear “right” or “wrong” answer.

In considering broader public safety issues, it may be helpful to consider some of the underlying normative questions. For example, should the sheer pain of an ECW electrical shock constitute an injury to the individual on the receiving end? Should puncture wounds be counted as injuries to subjects? Does the answer depend on where the puncture is located? Does the answer depend on whether the wounds heal quickly, or need treatment? These and other questions may provide a useful starting point for policy makers to answer the broader question of how ECWs impact the rates at which subjects are injured.

(4) HAS THERE BEEN STUDY OF OTHER WAYS TO ACHIEVE THESE GOALS?

DE-ESCALATION TECHNIQUES, GENERALLY

Many police executives around the country recognize the need to consider how officers can “de-escalate” potentially dangerous encounters, so that no force is ever required.²¹¹ The Police Executive Research Forum recommends training officers in “tactical disengagement” and “practicing strategies to de-escalate volatile situations.”²¹² Indeed, some research suggests that when officers are trained to use de-escalation skills, the likelihood of success in a crisis increases, and the use of force decreases.²¹³ However, we found no research that attempted to directly compare the effects of de-escalation techniques with the effects of ECW use.

Some researchers and experts have voiced concerns that the availability of ECWs has *reduced* the extent to which officers use de-escalation techniques. A group of researchers working on an NIJ-funded study noted that “[d]uring our interviews with officers and trainers, we heard comments that hinted at a ‘lazy cop syndrome.’ That is, some police officers may turn to [an ECW] too early in an encounter and may rely on [an ECW] rather the officer’s skills in conflict resolution or even necessary hands-on applications.”²¹⁴

While lauding ECWs, PERF has acknowledged that “in some instances it appears that officers are using the ECW inappropriately or too frequently.”²¹⁵ PERF has also recommended “avoiding over-reliance on weapons, such as Electronic Control Weapons, as opposed to hands-on tactics and verbal skills.”²¹⁶

²¹¹ [See #1 (“An Integrated Approach to De-Escalation and Minimizing Use of Force” (2012), which summarizes presentations at a 2012 PERF Summit where police chiefs and other experts described their experiences with the need for alternative crisis resolution techniques, as well as with the potential pitfalls of overreliance on ECWs. http://www.policeforum.org/assets/docs/Critical_Issues_Series/an%20integrated%20approach%20to%20de-escalation%20and%20minimizing%20use%20of%20force%202012.pdf. Accessed March 10, 2015.)]

²¹² [#1, p. iii.]

²¹³ [#37.]

²¹⁴ [#21, at p. 8-9.]

²¹⁵ [#15, at p. 15.]

²¹⁶ [#1, p. iii.]

CRISIS INTERVENTION TEAMS

Recognizing that mentally ill citizens are disproportionately represented among those arrested and involved in use-of-force incidents,²¹⁷ many jurisdictions—including Berkeley and others in the Bay Area—have implemented “Crisis Intervention Team” (CIT) programs in their departments.

CIT was developed in Memphis, Tennessee in 1988, and is often referred to as “the Memphis Model.” The full program includes three core elements: first, training for individual officers, which prepares them to respond to people in mental health crises; second, structural changes to dispatch and staffing policies, intended to ensure that appropriately trained officers will respond to calls for service likely to involve mental health issues; and third, the development of organizational ties between law enforcement and mental health systems.

Empirical literature on the impact of CIT programs is still developing. Past research has largely focused on changes in attitudes among officers who have undergone the training, and those results are encouraging.²¹⁸ So far, however, little empirical evidence exists to support a relationship between CIT training and reduced use of force, or reduced injuries to officers or suspects.

In a 2014 meta-analysis,²¹⁹ Sema Taheri surveyed the methodologically strongest CIT studies for findings on either of these measures. Taheri’s meta-analysis showed that “none of the studies resulted in significantly positive effects of CIT on use-of-force outcomes.”²²⁰ The author reported that only two methodologically qualified studies measured the effect of CIT on officer injury. Moreover, they both suffered from serious limitations, “highlight[ing] a significant gap in knowledge about CIT program effects on officer preparedness.”²²¹ Taheri concluded that, for now, there is “insufficient evidence to

²¹⁷ See “More Than Half of Those Killed by San Francisco Police Are Mentally Ill,” KQED, Sept. 30, 2014. The article notes that a “2013 report by the Treatment Advocacy Center and National Sheriffs’ Association estimates half of the people shot and killed by police in the U.S. ‘have mental health problems,’ and as many as one-third of officer-involved shootings are attempted ‘suicides-by-cop.’” <http://tacereports.org/storage/documents/2013-justifiable-homicides.pdf>. Accessed June 10, 2015.

²¹⁸ [#38, p. 532 (“Evidence suggests CIT training is effective in improving officers’ knowledge about mental illness and its treatment, attitudes toward persons with mental illness and interactions with them, and officers’ confidence about their ability to respond appropriately to mental health crises [citing three studies]”); *see also* #39, p. 15 (“CIT-trained officers transported the mentally ill to more community-based services rather than arrest them compared with their non-CIT counterparts”).]

²¹⁹ [#39.]

²²⁰ [#39, p. 11.]

²²¹ [#39, p. 11.]

conclude if these models reduce officer injury during encounters between police officers and persons with mental illness.”²²²

Despite the limitations of existing research, it is possible that CIT training reduces use of force and increases officer safety. As with many other police practices, however, the effect is difficult to measure because of the decentralized nature of policing in the United States. As noted in Taheri’s meta-analysis, “the practice of developing a CIT model can make evaluation very difficult in the production of primary studies.”²²³ Another author reviewing the CIT literature writes that “CIT implementation varies so much across localities that it is difficult to discuss the CIT model as a uniform intervention process.”²²⁴

²²² [#39, p. 15.]

²²³ [#39, p. 15.]

²²⁴ [#38, p. 530.]

Conclusion

Electronic control weapons have been widely adopted by police departments in California and throughout the United States. However, that seeming ubiquity does not settle the question of whether the Berkeley Police Department should deploy them, or under what circumstances. Instead, the developing empirical literature and the accumulated experiences of other jurisdictions demonstrate that important questions about ECWs are more complex than they appear.

Police officers are responsible for a difficult and often dangerous job. Those dangers and challenges are described with some elegance in the decisions of our highest courts, which recognize that “police officers are often forced to make split-second judgments—in circumstances that are tense, uncertain, and rapidly evolving[.]”²²⁵ It is easy to see why ECWs—which are designed to allow officers to quickly subdue resistant subjects with minimal danger—have been widely adopted with a promise that they can reduce the rate of injuries to police officers and suspects, and perhaps even reduce the use of lethal force.

At the same time, the introduction of a new weapon as a tool in policing inevitably comes with a set of attendant risks. Deciding whether to adopt ECWs requires balancing those potential risks against what is known of their benefits. If these benefits prove true, then ECWs would certainly enhance public safety. If, however, these benefits prove false or unsubstantiated, then adopting ECWs could create a series of risks, with no (or minor) measurable benefits.

The goal of this report was to examine whether the empirical research substantiates the perceived benefits and costs of ECWs. In other words, once you sift through the studies, cross-check their footnotes, and weed out weaker designs, can we identify the *measurable* costs and benefits of this technology?

We approached the hundreds of studies assessing ECWs hoping to find a body of robust empirical evidence either supporting or debunking the perceived benefits of the devices. Unfortunately, that was not our experience.

As we have noted throughout this report, even the best empirical evidence in this field is riddled with caveats that limit the confidence readers can place in results. The medical literature reflects the limits on what researchers can ethically test in a controlled setting. Structural issues make it difficult to gather reliable data about the results of ECW adoption by police officers. In many subject areas, small sample sizes or preliminary research designs limit generalizability. And in *every* area, we can say that the methods are

²²⁵ *Graham v. Connor*, 490 U.S. 386, 397 (1989).

still developing. For each conclusion, there is an asterisk—and often, an asterisk to the asterisk.

In short, our efforts to *identify* the evidence-backed benefits and costs have often required us to assess their *weight*. After spending so much time trying to understand how these pieces of evidence fit together, we have a few general conclusions about what the currently available evidence shows.

With regard to health impacts:

- The weight of the evidence tends to show that ECWs have distinct impacts on different segments of the population, and their relative safety also varies with the circumstances of any given interaction. If there is any broad-based conclusion to draw from the current research, it is that ECWs are usually safe for use on healthy people who are not under the influence of drugs, alcohol, mental illness, or pregnancy, so long as these individuals receive only a standard five-second shock to an approved area of the body.
- Some may read these findings to mean simply that ECWs are “generally safe.” However, the research also suggests that many people exposed to ECWs are likely have one or more of the risk factors addressed in the medical literature, such as being under the influence of alcohol or illicit drugs, or suffering from mental illness. Moreover, many of the medical studies rely on healthy male police officers as subjects. As a result, their conclusions are of only limited applicability. Finally, researchers are still exploring health effects even on these “ideal candidates.”²²⁶

With regard to the impact of ECWs on public safety:

- (1) **Do ECWs replace use of lethal force (gunfire)?** There is very little evidence to support this claim. It is certainly possible that ECWs save lives by replacing lethal force, and many researchers recognize the importance of the question. So far, however, no credible studies have demonstrated this claim empirically.
- (2) **Do they reduce [non-lethal] injuries to officers?** While the research on officer injuries is by no means unequivocal, there is strong support for the assertion that

²²⁶ See, for example, the January 2014 study by White et al. examining, for the first time, the effects of the TASER on cognitive functioning. [#16.] White et al. concluded that participant police officers “experienced statistically significant reductions in several measures of cognitive functioning following TASER exposure.” [#16, p. 12.]

ECWs reduce injuries to officers to some degree. However, the studies do vary as to the magnitude of the effect, and none have comprehensively addressed the *severity* of prevented injuries.

- (3) Do they reduce [non-lethal] injuries to suspects?** The answer is that it depends. At first glance, the literature appears to clearly establish a relationship between ECWs and reduced injuries to suspects. However, this dominant narrative masks a more complicated body of research that casts doubt on the conclusion. The answer appears to turn on the question of whether or not to count puncture wounds from ECW barbs as an injury in a statistical model, and, if the answer is yes, how to count them.
- (4) Are there alternative practices or tools that would accomplish these goals, other than deploying electronic control weapons (such a focus on de-escalation)?** Many departments have begun to turn their efforts to de-escalation and implementing Crisis Intervention Teams (CIT). Empirical literature on the impact of CIT programs is still developing. Despite the limitations of existing research, it is possible that CIT training reduces use of force and increases officer safety. As with many other police practices, however, the effect is difficult to measure because of the decentralized nature of policing in the United States.

Assessing how to weigh the ultimately unsatisfying answers to each question requires consideration of the normative issues we have referred to throughout this report—the judgments about how to balance important values like the safety of police officers with that of citizens. Balancing those values with regard to ECWs is especially challenging, not only because the data is incomplete, but also because the unusual features of this weapon that allow a user to inflict tremendous pain without leaving any apparent sign of lasting injury.

It is true that ECW adoption is not the only important public policy debate that suffers from a lack of quality information. Understanding the health effects of *any* substance or physical intervention—from ECWs, to trans fats—will be limited by the ethical boundaries that govern research into human subjects. Measuring the impact of *any* proposed public policy often requires drawing conclusions from datasets that suffer from some degree of limitation.

There is something particularly unsettling, however, about the lack of clarity surrounding questions that determine when and how the members of a community authorize the use of force against their neighbors. We believe that use-of-force policy decisions are too important to be left to conjecture, hunches, or passive adoption of conventional wisdom. After assessing all of this evidence, our own conclusion is that the “costs,” or potential harms, of using ECWs are not yet fully understood. We believe this calls for caution, and that ECWs should be adopted in very limited circumstances, if at all.

Where ECWs are deployed, we share the concerns voiced by many of the nation’s leading police executives, whose experiences with ECW adoption have convinced them that these tools are not a panacea.²²⁷ First, we believe that policy makers should consider coupling the adoption of ECWs with full-throttled efforts at de-escalation training. Second, policy makers should give careful consideration to best practices that reflect the experiences of jurisdictions with longer exposure to the benefits and pitfalls of ECWs.

Finally—as is true with the introduction of any new technology—policy makers must lay the groundwork for effective and continual ECW training. Our review of the research indicates that many of the risks associated with ECWs stem from ECW misuse. Many studies surveying the impact of ECWs include the caveat, “when used properly” If policy makers couple ECW adoption with efforts at continual professional development, they can mitigate some of the heightened risks associated with ECW misuse.

We acknowledge that reasonable people might disagree with our assessment. Our conclusion depends in large part on answers to normative questions—the “judgment calls” that may not have definitive answers because they implicate important values that are often tension with each other. We have approached our research with our own normative perspective, but we acknowledge that others might resolve those tensions differently. We hope that the research presented in this report will be helpful to the residents of Berkeley as they answer these questions for themselves.

²²⁷ [See #1 (“An Integrated Approach to De-Escalation and Minimizing Use of Force” (2012), which summarizes presentations at a 2012 PERF Summit where police chiefs and other experts described their experiences with the need for alternative crisis resolution techniques, as well as with the potential pitfalls of overreliance on ECW. http://www.policeforum.org/assets/docs/Critical_Issues_Series/an%20integrated%20approach%20to%20de-escalation%20and%20minimizing%20use%20of%20force%202012.pdf. Accessed March 10, 2015.).]

Appendices

APPENDIX A: BASIC FEATURES OF CURRENT TASER MODELS

The newest generation Taser models are the X2 and the X26P.²²⁸

The Taser X2 builds on a shortcoming of a previous X26 model; namely, the X26 model can only fire one cartridge without the officer reloading. “This can present a distinct disadvantage when one probe misses (since two are required to complete the electrical circuit), the probe spread is too close to be effective, or there are multiple subjects requiring engagement.”²²⁹ According to Taser International, the X2 model has a “powerful 2-shot option for increased effectiveness.”²³⁰ The X2 can fire two cartridges in a “semi-automatic” manner.²³¹ Additionally, the X2 model “has completely different waveform and output specifications that have significantly changed the electrical characteristics of this weapon when compared with previous [ECWs].”^{232, 233}

The second “new generation” model is the X26P. The X26P model retains the core features of the X26 model, but includes additional enhancements and safety features.²³⁴ The X26P is a single-shot model using the same cartridge as the X26 model.²³⁵ However, the X26P features improved ergonomics, weatherproofing, and an upgraded battery that lasts twice as long as the X26 battery.²³⁶ Additionally, the X26P model incorporates many of Taser International’s “Smart Technology” features.

Taser International markets “Smart Technology” features associated with both the X26P and X2 models. First, the company offers Trilog Logs, which monitor and record every

²²⁸ The X26P model builds on the X26 model, first introduced in 2003. [#3, p. 14]

²²⁹ [#78, p. 55.]

²³⁰ “Smart Weapons Are Safer Than Ever,” Taser International, <https://www.taser.com/products/smart-weapons>.

²³¹ [#8, p. 429.]

²³² [#8, p. 429.]

²³³ It is worth noting that most of the existing medical research, addressed in the “Health Effects” section (Part I, p. 11), was conducted using the X26 or the (now discontinued) M26 Taser model. The X2 model departs from the electrical characteristics of these prior models, and there is limited medical research assessing the health impacts of the X2 model.

²³⁴ “New TASER X26P Smart Weapon Announced,” Taser International, January 15, 2013, <http://investor.taser.com/releasedetail.cfm?ReleaseID=733541>.

²³⁵ *Id.*

²³⁶ *Id.*

user interaction with the Taser.²³⁷ Additionally, the company offers a digital management software called Evidence Lite,²³⁸ which stores and manages device data.

²³⁷ This includes safety activations, trigger duration with times, dates, battery life, and a pulse-by-pulse record of the charge output. “Smart Weapons Are Safer Than Ever,” Taser International, <https://www.taser.com/products/smart-weapons>.

²³⁸ “Smart Weapons Are Safer Than Ever,” Taser International, <https://www.taser.com/products/smart-weapons>.

APPENDIX B: NINTH CIRCUIT CASES ADDRESSING POLICE USE OF ECWS

	“NATURE & QUALITY OF INTRUSION” (Force Level)	“GOVERNMENTAL INTEREST” (Factors that would determine if force was justified—in these cases, the government interest was not high enough to justify force.)			
CASES	(1) PHYSICAL FX, (2) PAIN, (3) RISK OF INJURY	WAS THE CRIME “SEVERE”?	DID SUSPECT POSE A THREAT?	ACTIVELY EVADING / RESISTING ARREST?	OTHER FACTORS?
2010 <i>Bryan v. MacPherson</i>	Dart mode = Intermediate Force (paralysis, excruciating pain; here, high risk of injury: shirtless man in street, who fell, broke teeth)	Not severe. (‘No seatbelt’; officer claimed 3 misdemeanors: failure to comply, resisting, & being under influence)	Low Threat. (behavior erratic, not threatening; unarmed; wearing only boxer shorts; no threats; 20 ft from officer;	Passive, if any (man hit self in arms; shouted gibberish; complied with orders except one he says he didn’t hear: stay in car.)	<input type="checkbox"/> Police failed to warn before ECW use; <input type="checkbox"/> Less intrusive measures clearly available
2011 <i>Brooks v. Seattle</i>	Drive-stun = ? (court declined to specifically find what level of force it was, but distinguished from dart mode)	Not severe (Speeding & refusal to sign traffic ticket)	No Threat. (Pregnant woman at wheel of car, keys on floor; no threats; not armed)	Passive (refusal to leave car, clutching steering wheel, but didn’t flee or strike officers)	<input type="checkbox"/> Woman told officers she was 7 months pregnant; <input type="checkbox"/> Police tased her 3 times in 1 minute
2011 <i>Mattos v. Agarano</i>	Dart mode = “Intermediate force” (see <i>Bryan</i> , above)	No Crime (woman didn’t move aside for police officer who had entered home to arrest her husband)	No Threat (unarmed woman did not threaten police; only contact w/ officer was “defensively raising hands to prevent his pressing his body against hers”)	<input type="checkbox"/> No Resistance (at most, she failed to comply with an officers request immediately; was not herself under arrest)	<input type="checkbox"/> Police were responding to 911 call about a domestic dispute; upon arrival, they met plaintiff’s large, hostile, intoxicated husband.
2013 <i>Gravelet-Blondin v. Shelton</i>	Dart mode = “Intermediate force” (see <i>Bryan</i> , above)	If any crime, not severe. (Man failed to instantly comply with order to get back from scene of an arrest, when he was already standing 37 feet away.	Not threatening. (Fact that man asked officers “what are you doing to Jack?” doesn’t make him threatening)	No Resistance. (Man stood still for 15 seconds upon receiving order to “get back” and contradictory order to “stop”; officer then ran at man, yelling “get back,” fired ECW.	
2014 <i>Hesterberg v. U.S.</i>	Dart mode, 5 seconds = “Intermediate force” (see <i>Bryan</i> , above)				

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