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EFFICACY AND SAFETY OF ELECTRICAL STUN DEVICES

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Table of Contents

We would like to express our deepest gratitude to the members of the Executive Committee who were vital in the planning and execution of this conference. We appreciate their guidance and support throughout this endeavor.

General Al Gray
Dr. Bruno D.V. Marino
Mr. Tom O'Leary
Mr. Ken Stethem

Executive Summary

On February 23rd and 24th, 2005, The Potomac Institute for Policy Studies in Arlington, Virginia, hosted a two-day conference entitled "Stun Devices: Uncertainties and Gaps in Knowledge." The conference was co-sponsored by Aegis Industries, Inc. The purpose of the conference was to bring together experts from various fields including medical and health effects, safety and regulatory issues, policy, and industry practices, to discuss what we know about stun device technology and offer insight and suggestions on filling the current gaps in knowledge.

A plenary session was held to discuss the current status of the stun device debate, and the group heard from individuals regarding such issues as current research endeavors, policy concerns, regulations, and the status of the industry. The floor was open to discussion and input was encouraged and received from all members, which was beneficial in making sure all relevant issues were thoroughly addressed.

Conference attendees were then assigned to one of four breakout groups: (1) Policy, led by Dr. Dennis McBride of the Potomac Institute for Policy Studies; (2) Health Effects, led by Dr. Marom Bikson of the City College of New York; (3) Regulatory & Safety, led by VADM Thomas Barrett of the Potomac Institute for Policy Studies; and (4) Industry, led by Mr. Ken Stethem of Aegis Industries, Inc. These groups met with the objective of evaluating issues related to their domain, and developing conclusions and recommendations, which would be presented on Day 2, to all participants who were in the plenary session. The conference ended with a scheduled press conference to summarize the findings and recommendations from each group.

The conference thus served to inform the preparation of this manuscript. The Potomac Institute for Policy Studies is responsible for the information contained within the report. It is important to note that, as in any conference of world-class experts, there was not absolute unanimity on every conclusion reached. The purpose of this report is to objectively evaluate the relative efficacy and safety of stun devices in the context of law enforcement use, and in the near absence of federal governmental attention.

Synopsis of Findings:

- There is no universally accepted terminology or definition for non-lethal weapons in the realm of law enforcement. For our purposes, we adopted the Department of Defense (DoD) definition, and are convinced that this language is appropriate for use by stun device manufacturers and end users. The point of non-lethal technologies is that they are employed with an *intent not* to kill, but to incapacitate temporarily. The public should become educated on this fundamental issue of non-lethal technologies.
- The last and only federal regulatory review of stun device safety was conducted in 1976 by the Consumer Product Safety Commission. The technology evaluated at that time was found not likely to be lethal to normally healthy adults. We have found no report whose purpose was to claim that stun devices are ineffective or unsafe.
- We found a fundamental FDA philosophy to be useful for evaluating the safety and effectiveness of devices such as stun guns. This methodology considers the risks associated with a device *relative to its efficacy*, and considers no product to be completely devoid of risk.

- There are no federal restrictions or guidelines for stun device use—nor for importation from foreign suppliers for that matter. Moreover, there is no regulating body (private or public) and there are no industry standards.
- Due to the fact that law enforcement agencies are managed at the local level, placement of stun devices on the force continuum may vary amongst organizations. Although some organizations offer exemplary use of force rules, there is no universally agreed upon matching of tactics (use of force) with threatening behavior.

We found direct and indirect evidence specifically regarding the safety and effectiveness of stun technology:

- Indirect Evidence of Efficacy
  - Acquisition of stun devices by law enforcement agencies across the country is increasing substantially.
  - Organizations other than traditional law enforcement agencies have actively voiced support for stun device use as a non-lethal option.
- Direct Evidence of Efficacy
  - Individual law enforcement agency reports offer statistics on situational use and employment results, and a compelling majority of these report favorable success rates, particularly as compared to other techniques and devices.
- Indirect Evidence of Safety
  - Available animal modeling results offer confirming scientific evidence that the employment of stun technology is relatively safe.
- Direct Evidence of Safety
  - Examination of the 72 mortality cases appearing in an Amnesty International 2004 report reveals that in no instance was stun employment singularly indicated or implicated as the specific cause of death, although the application of stun devices could not be ruled out as a possible contributing factor.
  - Analysis of the 72 mortality cases showed that other contributing factors included pre-existing morbidity, such as heart disease; and other significant factors such as excessive drug ingestion, and multiple force applications (e.g., baton + wrestling + stun).

Study Conclusions:

- Based on the available evidence, and on accepted criteria for defining product risk vs. efficacy, we believe that when stun technology is appropriately applied, it is relatively safe and clearly effective. The only known field data that are available suggest that the odds are, at worst, one in one thousand that a stun device would contribute to (and this does not imply "cause") death. This figure is likely not different than the odds of death when stun devices are not used, but when other multiple force measures are. A more defensible figure is one in one hundred thousand.

- No federal regulative body has asserted oversight of current non-lethal stun technology. As a result, there is insufficient guidance for public and private management. One result of this deficiency is that there are currently no broadly accepted engineering standards in this field.

We believe that the establishment of industry-driven, government-endorsed standards will contribute significantly to better understanding of this technology domain. We expect better understanding will in turn help shape market (demand and supply) dynamics for products. Competition may also contribute to an increase in the community's self-management of safety issues.

- We strongly recommend that additional research be conducted at the organism, organ, tissue, and cell levels. The mortality figures cited could conceivably reflect inaccuracies in reporting or perhaps there are other factors, such as efficient and effective medical care availability. Moreover, the vast majority of targeted individuals have been relatively young males. The community needs to understand the specific effects of varying electrical wave forms on relevant organic matter of all body types in the immediate time frame of stun application, and in the downstream time course as well, to include possible psychiatric and other non-lethal effects.

Introduction and Statement of the Problem

We believe there have been well over 100,000 known actuations of electrical stun technology (or merely, stun devices or guns) by law enforcement officers over the last five years.[1] Several police and enforcement organizations confidently claim that the technology is safer and more effective than other non-lethal, and even lethal alternatives. However, there are reports of nearly 100 in-custody deaths that have occurred in association with the employment of stun devices. Although coroners' reports do not specifically indicate that stun employment "caused" death, there is legitimate concern that the significant electrical surge produced by this technology contributed to, or indeed perhaps even caused, death.

Opposition to (or at least critical concern regarding) stun device use is championed by non-government organizations such as the American Civil Liberties Union (ACLU), the Southern Christian Leadership Conference (SCLC), and Amnesty International. The ACLU has called on law enforcement agencies in Rhode Island, Colorado, and California to tighten use of force policies, and to only allow the use of stun devices in situations that present a "true threat" to human life. The SCLC recently held a rally in Pensacola, Florida to launch its national campaign against the use of stun devices, and intends to hold future hearings on stun device use in the State of Georgia. Amnesty International has undertaken the most critical review, and in the process, has done the stakeholder community a tremendous service by documenting the history of this technology, and chronicling episodes of stun employment, particularly in cases with unfortunate outcomes.

Reference to "stakeholder community" above is for our purposes a very important issue. Unlike nearly any other technological domain, there appears to be no U.S. government regulatory organization that has taken "responsibility" for stun device safety. That is, there is no "controlling legal authority" for stun technology regulation. Although the Department of Justice (DOJ) has begun a study on the safety of stun devices, to date, no Federal agency has taken ownership of the issue. The last government assessment of stun safety was conducted by the U.S. Consumer Product Safety Commission (CPSC) in 1976. It found that the product should not be lethal to a normally, healthy person.[2] Furthermore, the Bureau of Alcohol, Tobacco, Firearms & Explosives (ATF) has not classified the current 'conducted-energy weapon' as a firearm, since this proprietary technology uses compressed nitrogen gas as the propellant. The ATF has therefore offered no restrictions or guidelines for stun device use.[3]

So, although stun devices are guns, they are not firearms. They have been in commercial use significantly for nearly 30 years and there are unsubstantiated claims that they can kill. The salience of this issue has increased due in part to recent reporting of mortalities in temporal association with police use of stun devices. This study was conducted in order to clarify issues of effectiveness and safety of current stun technology.

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[1] The number of stun device actuations is constantly increasing. TASER International estimates the total number of actuations of TASER products only, to be around 200,000. While we acknowledge the continually increasing total, in order to make consistent calculations we will use 100,000 as the actuation figure.

[2] See May 2, 1985 press release # 85-022 from the Consumer Product Safety Commission. Available at www.cpsc.gov/CPSCPUB/PREREL/prhtml85/85022.html.

[3] Interestingly, there are Second Amendment issues associated with stun devices. Anticipated case law here will be very important from a policy perspective.

Background: Efficacy and Safety of Stun Device Technology

Electrical stun technology has been available and commercially traded for more than a quarter century. The original market, of course, was focused on private purchase in support of personal security. The leading manufacturer of stun devices, TASER International, Inc., reports that it has retailed roughly 100,000 devices for private use, and that approximately 135,000 units have been sold to law enforcement organizations. Sales of the devices indicate clear and growing demand. The TASER-specific units range in cost from around $400 to upwards of $1,000 and as a result, retail demand for personal use is arguably dominated by middle-and-upper income individuals and families.[4]

Stun devices are currently used by some 7,000 law enforcement agencies in the United States. However, use of these devices is limited or made unlawful in certain jurisdictions. A summary of legal and policy restrictions is shown in Table 1. It is reasonable to assume that restrictions on, or the criminalization of, stun use are derived from concerns regarding safety, and not from doubts concerning the technology's effectiveness.

Table 1. State & Local Limitations to Stun Device Use[5]

STATES WHERE STUN DEVICES ARE ILLEGAL	
Hawaii	Hawaii State Law. Rev. Stats. Title 10, Chapter 134.
Massachusetts	Massachusetts State Law. Ann. Law of Massachusetts. Chapter 140.
Michigan	The Michigan Penal Code Act 328 of 1931. Chapter 750.224a
New Jersey	New Jersey State Law. New Jersey Stat. Ann. Title 2C. Chapter 39-1. Senate, No. 2871 -- L.1985, c. 360
New York	New York Consolidated Law Book 39. Penal Law. Article 265
Rhode Island	General Laws of Rhode Island. Title 11, Chapter 47. Statute Subsection 11-47-42.
Wisconsin	Wisconsin Sta. Ann. Chapter 393. Chapter 941.295
STATES WHERE STUN DEVICES ARE LEGAL, BUT WITH SOME RESTRICTIONS	
Connecticut	Connecticut Criminal Law Title 53 - Crimes, Title 53a - Penal Code, title 54 Criminal Procedure, Chapter 950 Section 53a-3
Florida	790.001 (15)
Illinois	Identification Card Act. Chapter 720. Criminal Law and Procedure, Article 24. Deadly Weapons.
Indiana	IC 35-47-8
North Carolina	§14-269
North Dakota	North Dakota Century Code Title 62.1 and Article 10-12

[4]There is a "secondary market" within stun device retail, in that consumers can purchase devices at a much lower rate through the Internet. We anticipate that future issues may arise here, after consumers are unable to verify the origin or manufacturer of the device.

[5] State and city code information available through several retail sites including http://www.1stlinesecurity.com/stunres.html and http://www.beststungun.com/stun-gun-laws.html#den

Washington	House Bill 1580, adding new chapter to Title 9 RCW
CITIES WHERE STUN DEVICES ARE ILLEGAL	
Annapolis, MD	Section 11.44.070 Electronic weapons (Ord. O-59-85 § 1: prior code § 17-35)
Baltimore, MD	Baltimore City Code 115. (Ord. 385.1985)
Howard County, MD	Sec. 8.404 (C.B. 38 1985)
District of Columbia	DC Code Ann. Title 6, Chapter 23. Firearms Control.
Philadelphia, PA	Philadelphia City Ordinance. Statute 10-825 Stun Guns.

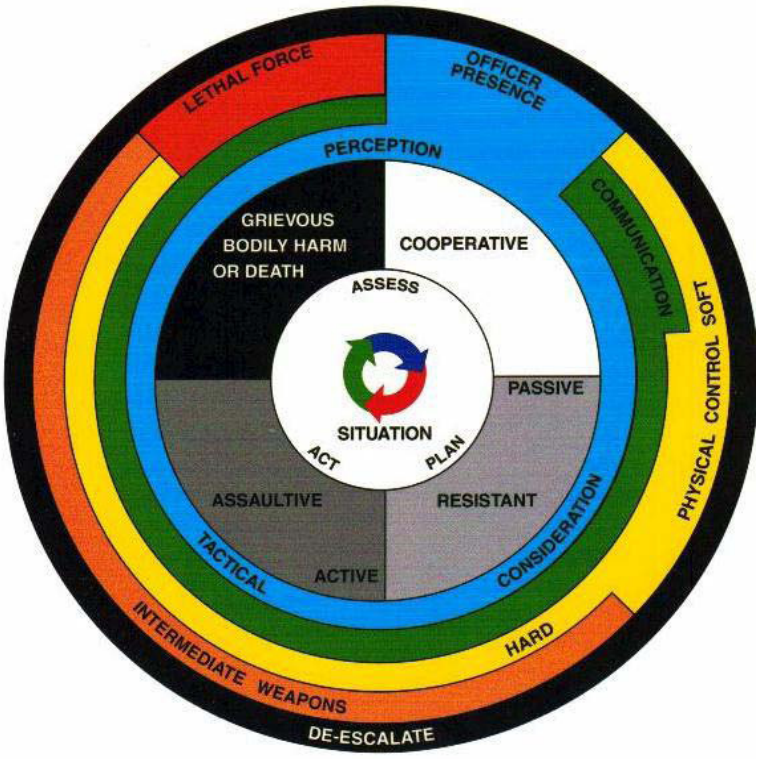
The use of stun technology by law enforcement agencies has increased significantly over the past five years. Indications of growth include sales figures for the principal supplier, TASER International, Inc. TASER revenue has grown from around $2.2 million in 1999, to an estimated $67 million for fiscal year 2004.[6] In addition, a number of police organizations (and individuals) have specifically and publicly claimed that the technology is very effective, and represents a vital capability in the force repertoire.[7] Clearly, the devices do represent an option in law enforcement's "force continuum." Whereas stun devices provide a means short of deadly force, they are arguably more effective, and even safer than other elements of the dimension, such as baton use or employment of chemical sprays. Figure 1 shows a graphic of the Canadian Use of Force Model; it provides a representative depiction of the relationship between "force" and the types of "threat" that are encountered by police.[8] Because law enforcement is regulated by individual states, there is no national use of force model in the United States. However, organizations such as the International Association of Chiefs of Police, exemplar rules of engagement (through the National Law Enforcement Policy Center) for law enforcement agencies on such issues as use of force, electronic control weapons, and other less than lethal weapons.

[6]The SEC makes TASER International, Inc. company financial filings available through the EDGAR system at http://www.sec.gov/edgar/searchedgar/webusers.htm

[7] This statement is supported by numerous individual agency reports including those from Chandler, Arizona; Cape Coral, Florida; Madison, Wisconsin; and Orange County, Florida.

[8] This model is taken from the September 2004 British Columbia Police Complaint Commissioner report on Taser Review. The terms used for Canadian subject behavior levels correspond to the following U.S. resistance level terms: Cooperative/Cooperative; Passive Resistant/Verbal Non-Compliance; Active Resistance/Defensive Resistance; Assaultive/Active Aggression; Grievous Bodily Harm or Death/Deadly Assault.

Figure 1: Canadian Use of Force Model



Without providing detail here, it is important to note that police organizations develop tactics, and train on selecting context-dependant force options based on perceived levels of aggressive behavior. Police necessarily react to behavior and not intent. A conceptual set of considerations can be inferred from the figure and is confirmed anecdotally by police organizations as follows: (1) the stun option provides a satisfactory alternative relative to the use of deadly force; (2) the stun option does not represent (A) an unsatisfactory alternative to a perhaps less aggressive option and as a result, (B) it does not produce collateral consequences (e.g., death or injury) that would not have resulted with the (claimed) less aggressive option. We must turn to the available evidence to confirm or disconfirm these key claims.[9]

[9] It is important to note that many states are placing stun devices on the same level of the force continuum as oleoresin capsicum(OC) spray (due to ease of subject "after care"), which is lower than impact weapon use and lethal force. Information available at www.policemag.org

Evidence Regarding the Efficacy and Safety of Stun Technology

The two fundamental and obvious technical questions associated with the employment of non-lethal devices in general, and electrical stun technology in particular, are as follow: (1) are they effective, and (2) are they safe? "Safe" and "effective" are of course relative terms, and therefore must be (A) clarified, (B) quantified, and (C) objectively evaluated. Perhaps the largest contribution to confusion over the stun device debate is a lack of precision in terminology. We believe that clarity and universality of definitions is vitally important, and thus we provide the following treatment of terms and concepts.

Non-Lethal Devices Defined. Military forces have long used tactics, techniques and procedures that range from extremely lethal, to those that are considerably less than lethal. Fundamental to this military continuum that is at least as old as Sun Tzu, and typical of today's military-engineering-legal enterprise, formal definitions have been vetted and adopted in military parlance. We commend the DoD definition of non-lethal weaponry as follows:

> *"Weapons that are explicitly designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired collateral damage to property and the environment."*[10]

The importance of this definition is the emphasis placed on the intent of employment, and not on the unintended outcome of employment. That "force" is used necessarily implies potential harm to tissue or organs, but, at least as military doctrine clearly articulates, the intention of non-lethal technology is not to kill, but rather to incapacitate—and to do so temporarily. Although we know of no similarly published doctrine from law enforcement organizations, we believe that the military definition of non-lethal technology is particularly appropriate in the case of stun devices in law enforcement, and thus we have adopted it for our purposes.

Efficacy (or Effectiveness) and Safety Defined. There are several philosophical models that can be used to frame and subsequently, to define the relative effectiveness—and relative safety of a particular technology. These range from the engineering rigor of military test and evaluation processes, to business-related analyses of product movement to consumers. We chose to follow a conservative Food and Drug Administration (FDA) philosophy for defining efficacy and safety, primarily because of the putative life-and-death matters that have been made central to the stun device debate.

A thematic characteristic of FDA product regulation is the following: efficacy and safety are not examined as mutually independent variables. The fundamental precept of FDA regulation is best portrayed from the source itself: "Although (medical products) are required to be safe, safety does not mean zero risk, since all (medical products) are associated with risks. A safe (medical product) is one that has reasonable risks, given the magnitude of the benefit expected and the

[10] DoD Policy Directive 3000.3, updated November 2003.

alternatives available," (U.S.FDA[11]; The reader may substitute "law enforcement devices" for "medical products").

No useful technology is perfectly safe. This can be said of *any* technology, even devices that are designed specifically and exclusively to save lives, such as seatbelts or air bags—which themselves can and do kill (to be discussed in relative terms later). The question of efficacy and safety thus decomposes to the following efficacy dominated concerns (A) Does the technology do what it is intended to do at the behavioral level? Does it provide an effective option among force options? Is it an alternative to deadly force, or is it an alternative for other, perhaps less "aggressive" non-lethal tools? Does it incapacitate targeted individuals and targeted individuals only? What is a perpetrator's perception of the use of this technology vis-à-vis other force options? Safety-oriented interrogatives include: (B) Is the underlying effect (physiologically) understood, and is it reasonable, given the claimed effectiveness? Let us first consider the sources of evidence and then provide an interim assessment.

Table 2 depicts the realm of possible sources of evidence that are considered presently. Information available includes directly applicable data from field experience, and indirectly applicable data from laboratory research and other more or less formal studies. We were not convinced that all of the questions outlined in the former paragraph could be answered with confidence at this time. We have concentrated on the two principal issues: efficacy and safety.

Table 2: Currently Available Evidence Sources

	DIRECT	INDIRECT
Effectiveness	Anecdotal Reports Law Enforcement Agencies	Sales to Police Departments Non Law Enforcement Activity
Safety	Medical Reports Volunteer Episodes	Laboratory Studies Modeling & Simulation

Direct Evidence of Effectiveness. Direct evidence of effectiveness derives from police reports. These are almost invariably positive. The difficulty here is that critics may reasonably argue that police organizations have a bias in favor of stun devices, and that this bias contaminates any self-report of effectiveness. However, we believe that this is blindly dismissive of law enforcement reporting. Summaries from various law enforcement agencies show a consistent pattern of contexts, and of outcomes of use. The Los Angeles Sheriff's Department, for example, claims a 94 percent effectiveness rate for stun devices. This compares very favorably with success from other techniques and devices such as pepper spray. The latter is believed to provide no better than an 85 percent effectiveness rating. We know of no evidence of targeting, accuracy, or reliability issues that might compromise the effectiveness of stun technology.

[11] U.S. FDA Report (May 1999) *Managing the Risks from Medical Product Use. Part 1: Background – What are the Risks and What is FDA's Role in Managing Risk?*. The reader may substitute "law enforcement devices" for "medical products".

Indirect Evidence of Effectiveness. Indirect evidence for efficacy derives primarily from the fact that purchases by law enforcement agencies continue to increase. Based on the assumption that local and state governments make budget decisions in a competitive, vetted, and publicly accountable way, the simple observation that purchases (and repeat customership) continue to increase is an indirect but strong suggestion that the devices are doing what they are purchased to do.

Indirect evidence also arises from the fact that enterprises other than traditional law enforcement agencies, as well as foreign governments such as the U.K., France, and Finland are utilizing this technology. Other support can be inferred from recent decisions by the Department of Homeland Security (DHS) and Transportation Safety Administration (TSA), which now approves the deployment and use of stun devices by specially trained personnel on board commercial aircraft. A 2004 USA Today article noted that stun devices are the only non-lethal weapon that could be used safely on airline flights.[12] Groups such as the Airline Pilots' Association (ALPA) believe that these devices can be valuable for cabin security. Currently, flight attendants are not permitted to carry firearms, therefore the stun device creates an option for securing and protecting the aircraft and its passengers. The Association of Flight Attendants supports this policy, although currently no domestic airline carrier has deployed stun devices on their aircraft. It should be noted, however, that several foreign carriers are using this technology on international flights.

Direct Evidence of Safety. The most direct evidence of safety for stun technology derives from examination of post deployment, or use reports. The range of outcomes available here varies from incidents of in custody mortality, to episodes in which no apparent medical sequelae obtain at all (i.e., no morbidity). Amnesty International has produced an annotated tabularization of the 72 mortality cases known at the time of its publication.[13] Examination of each case reveals that in no instance was stun employment singularly indicated or implicated as the cause of death. On the other hand, causes of death normally address vital organ (brain) function or cessation; thus stun device employment to the body would not ordinarily be listed as a cause, per se, but rather as a possible contributing factor. Records of the mortality events reveal other consistent and significant patterns, to which we turn next.

The average age of those who died was 36.5, and all but one were apparently male.[14] Depending on the criteria used, 25 to 33 individuals died as the result of drug overdose, as specifically indicated by Coroner or Medical Examiner reports.[15] This included over-dosages of cocaine (19 to 26 cases) and methamphetamine (6 to 7 cases). The level of detail in the documentation shows that unequivocal, multiple use of force was evident in 44 cases. If we subtract the cases in which handcuffing was used without clear indication of significant force, 40 cases

[12] Levin, A. and Woodyard, C. (2004, November 08). "Stun Guns OK'd for use on airline". *USAToday*, p. 1A. Retrieved March 1, 2005 from http://www.usatoday.com/printedition/news/20041108/1a_bottomstrip08_dom.art.htm

[13] See Appendix A of Amnesty International. (November 2004). United States of America: Excessive and lethal force? Amnesty International's concerns about deaths and ill-treatment involving police use of tasers. Retrieved February 11, 2005, from https://web.amnsety.org/library/index/ENGAMR511392004

[14] This inference is based on the first names of the deceased. The single female was actually a fetus.

[15] There is inconsistency based on reporting standards across jurisdictions. We report the most conservative calculations based on scrutiny of the Amnesty International compilation.

required multiple use of force. There is only one case in which only stun use was applied (see below for details). These multiple force cases included forceful restraint (often requiring several officers wrestling the individual to restraint, "hog-tieing," sometimes to a position that compromised breathing), baton use, chemical spray application, and stun use. There were 14 double-use (e.g., baton and stun) incidents, 24 triple use events, and 6 cases in which 4 or more types of force were employed. The modal application (based on unequivocal reporting) was three forms of force (mean = 2.8; median = 3). This indicates of course that no single application of force used (restraint, stun, etc.) can be singularly identified as the leading element among the "cause of death" contributors. The number of stun applications per individual ranged from 1 to 13 (the latter figure is an outlier—the range otherwise was 1 to 6 stun applications). Median and modal stun application were approximately 2 applications per individual (though the mean = 3.57 due partly to the outlier). From the annotation, it does not appear that any death occurred during or immediately after stun application[16].

Following is a synopsis of the six accounts in which stun application was specifically cited as a salient contributor to death. Average age for these individuals was approximately 39, and use of force was multiple in all cases. Significant heart disease was specifically cited in two cases, and drug overdose (or failure to take prescription medication) was evident in all but one case. The single case in which stun application was the only force used in a death-related case was for an individual who fell, presumably as the result of loss of postural control, and sustained a fatal injury to the head—i.e., before law enforcement officials were able to access the individual. Thus, from Amnesty's compilation, we are able to confidently isolate stun device application as the principal contributor to death in one instance, and this was due to secondary means (by falling). The pattern almost invariably associated with deaths wherein drugs were involved, and in which stun and other devices were employed, appears to be that of nearly super-human physical struggle, principally against law enforcement officials. A nascent but increasingly respected medical interest in the associated medical trauma is converging on a constellation of symptoms that are being termed "excited delirium syndrome."[17] Here, in theory, "patients" "out-run" their aerobic reserve and expire, either through fibrillation or otherwise. A key point should be made here: excited delirium syndrome implies mortality caused by multiple factors over-driving the cardiovascular-pulmonary system, and not heart failure produced through electrical surge (from a stun device) applied to or conducted to the heart.

Death associated with in-custody episodes in which stun devices were *not* used also occur, of course. Civilians Down, an advocacy and support group for families who have lost loved ones while in police custody, report that nearly 1,000 people die in police custody each year.[18] This sets up an important hypothesis relative to the isolated contribution of stun devices to in custody demise. If stun devices are "the cause," and not merely a contributing factor, then there should be significantly more deaths after or during in custody stun-use evolutions than for other (e.g., chemical spray or

[16] This finding is important in light of the fact that when electric defibrillation devices are applied in order to purposefully change heart rhythmicity, the effect is immediate. It is also important to note that defibrillation devices are applied proximal to the heart, surge to 60 Amperes, and do not cause heart attacks, but rather reverse them.

[17] Excited Delirium Syndrome or Acute Exhaustive Mania were cited as cause of death in several of the Amnesty International compilation cases.

[18] Information is available at www.civiliansdown.com.

baton use) episodes in which stun devices specifically were not used. The evidence here favors the conclusion that stun devices cannot be isolated as the sole, or even a principal cause of death.[19]

In summary of the cases cited to date, if we consider the incidents in which stun technology contributed (singularly or in combination) to death, the range is from 1 to 72 mortalities. If we also accept that the applications of stun devices (for demonstration, or for effect) range from 60,000[20] to 100,000, the probability of death being associated with stun application ranges from 1 (specific death) in 100,000 (custodial + demonstration uses); to a maximum of 72 (temporally-associated deaths) in 60,000 (custodial uses[21]). This means that a safety factor for stun application is on the order of 0.999 to 0.99999. Stated another way, the probability of death after stun device administration to the body is from one in a thousand to one in one hundred thousand. Looked at from a different probability perspective, the likelihood of death due specifically to air bag deployment in modern automobiles is such that for every 50 individuals saved, one is killed.[22] One stun device manufacturer claims that stun devices have saved some 7,000 lives. If true, the most conservative saved/killed ratio for stun devices is 70:1. Based on the data cited above, this number is more likely 700:1 or greater.

A second set of direct data derives from an informal assessment of approximately 40,000 employments of stun devices applied to volunteer law enforcement officers. This process serves the purpose of teaching police the effects of the electrical surge from a personal involvement level, and it thereby presumably inspires some increment of wisdom before the device is used on private citizens. We have found no evidence of mortality or morbidity when police are voluntarily stunned. A legitimate argument here is that this is a faulty sample set because the vast majority of police officers are healthy young males with no exotic drugs in their systems. On the surface, this is a fair criticism. However, in reality, the vast majority of those who have been incapacitated by stun devices were themselves young males. Indeed the Amnesty International compilation cited above included nearly exclusively male (average age, mid-thirties) targets.[23]

Indirect Evidence of Safety. The best available indirect evidence of stun device safety comes from modeling efforts, either *in vitro*, *in vivo* (with live animal models), or *in silico* (modeling and simulation). The quantity of information available is not formidable, but the quality of the

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[19] As one example, a March 1994 report derived from data collected by the International Association of Chiefs of Police (IACP) states: "*A total of 30 incidents were found between August of 1990 and December of 1993 in which the death of a subject occurred following a spraying with OC. The 30 cases, all involving male decedents, share several commonalities. All subjects behaved in a combative and/or bizarre manner and struggled with the police. Drugs and/ or alcohol were involved in most cases. In the majority of cases, OC spray was either ineffective or less than totally effective. Generally, restraint techniques were employed subsequent to spraying, and with one exception, all deaths occurred either immediately or soon after the confrontation.*" The full report can be found at: http://www.zarc.com/english/other_sprays/reports/iacp_oc_death_1994.html.

[20] See next paragraph.

[21] We are obviously using disparate data sets for numerator and denominator here in order to derive a worst-case estimate for possible stun device lethality.

[22] This conclusion is based on National Highway Transportation Safety Board data reporting that from 1990 through 2004 there were 253 confirmed, and 22 unconfirmed airbag related fatalities. The same NTSB data estimates that airbags have *saved* a gross number of between 13,385 and 16,537 drivers, and 3,152 front-right side passengers. http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/TextVer/Anchor-SC-29958

[23] Without elaboration here, one reason that being relatively young and male is partly inoculative is that the skin, musculature, etc., are more voluminous and thus arguably provide more resistance (ohms) and thus more protection for the heart.

evidence is instructive. We will provide a very brief overview. In fact, we will concentrate on one recent government study.

A recent experimental examination of stun efficacy and health effects was conducted at the U.S. Air Force Research Laboratory. A briefing of the study is available from the Air Force as U.S. Air Force Research Laboratory Technical Report AFRL-HE-BR-TR-2004-0094, September 2004. Dissemination is controlled by DoD Directive 5230.25. The report does not appear in the peer-reviewed literature at this time, however the information in the available briefing is clear. The effort specifically examined the effectiveness (muscle contraction) and cardiac safety (ventricular fibrillation) of stun device application (representing the dose characteristics of a TASER International X-26 product) to swine. The technical community believes this animal to be the best model (due to heart-to-body ratio, etc.) for this type of research.

First, with regard to effectiveness outcomes, it is clear that the stun devices succeeded in causing muscle contraction in the limbs and in producing loss of posture. So at the behavioral and physiological level, evidence of effectiveness seems unequivocal. There is nothing surprising here—this is consistent with reports from law enforcement evolutions with humans, at least at the behavioral level.

With regard to health effects, there were no reported mortalities—no pigs died as the result of stun exposure. In order to understand more fully the physiology of *potential* damage to the body, chemical blood substances known or thought to be associated with muscle damage were collected. In summary, blood pH became more acidic, but returned to normal within an hour of exposure; lactate increased and slowly returned to normal; blood CO_2 increased after application but returned to normal within one hour; serum potassium increased, but returned to about six percent of normal within one hour. Although recommending further study, in summary here, the government reported no evidence of heart attack, nor evidence of enduring, down stream effects based on lagging indicators in blood plasma chemistry.

It is very important to underscore the importance of the dosage levels used in this experiment. Electrical pulses were applied to the animals for 5 seconds, each followed by a period of 5 seconds of no exposure. This on-off pattern was repeated continuously for 3 minutes. At the conclusion of this 180-second mode, a one-hour delay was imposed, and the same treatment was applied for another three minutes to each animal. Thus at six exposures per minute, the porcine models received 18 stuns per period, and thus 36 stun dosages, total. Recall that in the Amnesty International compilation of human mortalities, the average number of stuns was reported to be less than five (in fact mode = 2; mean = 3.57). That is, the pigs in the Air Force study received an order of magnitude more stuns than did the humans in the Amnesty International database. This experimental dosage appropriately minimizes the odds of making an inferential error: That no pig died or showed evidence of sustained (plasma substance) morbidity—despite the very high dosage levels—supports a claim of (relative) safety for the stun device, at least as used under experimental control conditions (e.g., placement of terminals on the animal, etc.).

Conclusions

Based on the available evidence, and on accepted criteria for defining product risk vs. efficacy, we believe that when stun technology is appropriately applied, it is relatively safe and clearly effective. The only known field data that are available suggest that the odds are, at worst, one in one thousand that a stun device would contribute to (and this does not imply "cause") death. This figure is likely not different than the odds of death when stun devices are not used, but when other multiple force measures are. A more defensible figure is one in one hundred thousand.

No federal regulative body has asserted oversight of current non-lethal stun technology. As a result, there is insufficient guidance for public and private management. One result of this deficiency is that there are currently no broadly accepted engineering standards in this field. We believe that the establishment of industry-driven, government-endorsed standards will contribute significantly to better understanding of this technology domain. We expect better understanding will in turn help shape market (demand and supply) dynamics for products. Competition may also contribute to an increase in the community's self-management of safety issues.

We strongly recommend that additional research be conducted at the organism, organ, tissue, and cell levels. The mortality figures cited could conceivably reflect inaccuracies in reporting or perhaps there are other factors, such as efficient and effective medical care availability. Moreover, the vast majority of targeted individuals have been relatively young males. The community needs to understand the specific effects of varying electrical wave forms on relevant organic matter of all body types in the immediate time frame of stun application, and in the downstream time course as well, to include possible psychiatric and other non-lethal effects.

Appendix A: Bibliography

ACLU Urges Rhode Island Police to Shun "Stun Guns". (2004 September 2). Retrieved March 9, 2005, from http://www.aclu.org/PolicePractices/PolicePractices.cfm?ID=16369&c=25.

ACLU Urges San Francisco Police Commission to Exercise Caution in Use of Tasers. (2004 September 21). Retrieved March 9, 2005, from http://www.aclu.org/PolicePractices/PolicePractices.cfm?ID=16559&c=25.

Amnesty International. (November 2004). *United States of America: Excessive and lethal force? Amnesty International's concerns about deaths and ill-treatment involving police use of tasers.* Retrieved February 11, 2005, from https://web.amnsety.org/library/index/ENGAMR511392004

Anglen, R. (2004, July 18). Taser safety claim questions. *The Arizona Republic.* Retrieved March 9, 2005, from http://www.azcentral.com/specials/special19/articles/0718taser-main18.html.

Badertscher, N. (2005, February 15). SCLC calls on police to stop using stun guns. *The Atlanta-Journal Constitution.* Retrieved February 16, 2005, from http://www.ajc.com/news/content/metro/legis05/0205/15legtaser.html.

Berenson, A. (2004, December 7). Justice Dept. Begins Study of Safety of the Taser Electric Gun. *The New York Times,* p. C6.

Bleetman, A., Steyn, R. (2004, April 27). *The Advanced Taser: a Medical Review.* Retrieved February 21, 2005 from TASER International Inc. website: http://www.taser.com/documents/tasersubmit.pdf

Bozeman, W.P. (2003). Medical threat assessment: The Taser M26 less lethal weapon. *The Tactical Edge,* 32-34.

British Columbia Office of the Police Complaint Commissioner. (2004).*Taser Technology Review and Interim Recommendations.*(OPCC File No. 2474).

Bronson, P. (2005, February 22). Taser deaths grossly exaggerated. *The Cincinnati Enquirer.* Retrieved March 1, 2005 from http://news.enquirer.com/apps/pbcs.dll/article?AID=/20050222/COL05/502220309/1004.

Chernicky, D. (2005, March 3). Taser popular with cops. *Daily Press.* Retrieved March 3, 2005, from http://www.dailypress.com/news/local/dp-4870sy0mar03,0,2099248.story?coll=dp-news-local-final.

Citing Deaths in Police Custody, ACLU of Colorado Calls For Limits on Use of Electroshock Weapons. (2004, February 26). Retrieved March 9, 2005, from http://www.aclu.org/CriminalJustice/CriminalJustice.cfm?ID=15167&c=15

Coroner rules Taser a factor in death; use called justified. (2005, February 24). *Associated Press.* Retrieved March 1, 2005, from http://www.azcentral.com/news/articles/0224taserdeath-ON.html

Dahlin, A. (2005, February 24 – March 2). SCLC Rallies In Taser Gun Controversy. *The Pensacola Voice.* Retrieved March 9, 2005, from http://www.pensacolavoice.com.

Davison, N. and Lewer, N. (2004). *BNLWRP Research Report No. 6*. Centre for Conflict Resolution, Department of Peace Studies, University of Bradford. Retrieved February 21, 2005, from http://www.brad.ac.uk/acad/nlw/research_reports/.

Fujimoto, L. (2005, February 17). Injuries to officers, suspects cut by MPS's use of Tasers. *The Maui News.*

Hoover's Online—Financial Fact Sheet. Retrieved March 9, 2005, from http://www.hoovers.com/taser/--ID__105070--/free-co-fin-factsheet.xhtml.

International Association of Chiefs of Police. (2001) *Police Use of Force in America.* Available through the IACP website at http://www.theiacp.org/documents/pdfs/Publications/2001useofforce%2Epdf.

International Electrotechnical Commission. (1994). *Effects of current on human being and livestock.* (Technical Report-Type 2, Publication 479-1).

Johnson, K. (2005, February 16). Deaths prompt concerns, reviews on use of stun guns. *USAToday,* p. 1A.

McDonald, W.C., Stratbucker, R.A., Nerheim, M., and Brewer, J.E. (2005). Cardiac Safety of Neuromuscular Incapacitating Defense Devices. *Pacing and Clinical Electrophysiology*, 28, 284-287.

Oshier, A. (2004, December 8). Professor studies taser use—results shocking. *NBC News 2.*

Rathbun, A. (2005, February 28). Experts: Taser guns need more study. *Northwest Indiana Times.* Retrieved March 1, 2005, from http://www.thetimesonline.com/articles/2005/02/28/news/top_news/ffb6c7bd8fb039f286256fb600014e6d.txt.

Schulz, W. and Smith, R. TASER International/Amnesty International Debate [Debate Transcript]. (2005, March 9) *at* Claremont McKenna College. Retrieved March 16, 2005, from www.taser.com.

Study Questions Stun Gun Safety. (2005, February 9). *CBS News.* Retrieved March 1, 2005, from www.cbsnews.com/stories/2005/02/09/eveningnews/printable672709.shtml.

Townsend, E.J.S. (2005, February 28). Police await Taser study results. *Greensboro News & Record.* Retrieved March 1, 2005 from http://www.news-record.com/news/local/gso/taser022805.htm.

U.S Department of Transportation National Highway Traffic Safety Administration, National Center for Statistics & Analysis. 4th Quarter 2004 *Air Bag Fatality Summary Report & Tables.* Available at http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/TextVer/Anchor-SC-29958.

U.S. Food and Drug Administration. (1999, May) *Managing the risks from medical product use: creating a risk management framework report to the FDA Commissioner from the Task Force on risk management.* Retrieved March 7, 2005, from http://www.fda.gov/oc/tfrm/Part1.html

Walton, R.D. (2005, February 16). Stun guns aren't for public, police say. *The Indianapolis Star.* Retrieved February 16, 2005, from http://www.indystar.com/articles/4/222629-7984-P.html.

Ward, K. (2005, February 19). Taser usage by local officers unchanged despite controversy. *Northwest Arkansas Times.* Retrieved March 1, 2005 from www.nwanews.com/story/nwat/25502.