

Date: September 29, 2011

Mansour, Gavin, Gerlack & Manos Co., L.P.A.
Attn: Timothy T. Reid and Michael Quinlan
55 Public Square, Suite 2150
Cleveland, Ohio 44113-1994

Re: *David Lee Nall, et al. vs. City of Painesville, et al.*
U.S. District Court, Northern District of Ohio,
Eastern Division, Case No. 1:10-CV-2883

Dear Mr. Reid and Mr. Quinlan:

I have been retained by your office to review an incident that occurred on June 26, 2010 in the City of Painesville, Ohio. The incident involved an altercation between Mr. David Lee Nall and officers from the City of Painesville Police department. My analysis of the situation follows and is based on my background, education, training and experience and is supported by the latest research and writings in the law enforcement profession.

I have been retained in over 300 police related cases, providing case analysis, development, and expert witness testimony. I have been qualified in State and Federal Courts, in Defensive Tactics/Subject Control, and in police and correctional procedures. I have been a Taser Instructor for approximately ten years. While being employed at the Ohio Peace Officer Training Academy, I acted as an assistant in numerous Taser Instructor courses that were taught by a master Taser Instructor. I have also attended and been a presenter in numerous seminars on conductive energy devices. My personal resume is attached as an exhibit to this paper.

In formulating my opinions I have reviewed the following documents and materials:

1. Civil Complaint And Jury Demand;
2. Painesville Police Report;
3. Deposition transcript of David Lee Nall;
4. Deposition transcript of Rebecca Nall;
5. Deposition transcript of Eric L. Silvi;
6. Deposition transcript of Gerald F. Lynch;
7. Deposition transcript of Officer Jason Anthony Hughes;
8. Deposition transcript of Toby Jon Burgett;
9. Deposition transcript of Officer William Collins;
10. Deposition transcript of Officer Nicholas A. Sholtz;
11. Deposition transcript of Paul Algier;
12. Deposition transcript of Lieutenant Robert Mrosko;

13. Deposition transcript of Officer Roberto Soto;
14. Deposition transcript of Officer Russell Frank Tuttle, Jr.;
15. Deposition transcript of Troy Hager;
16. Deposition transcript of William Charles Smith, April 29, 2011;
17. Deposition transcript of Officer William Charles Smith, Jr., June 20, 2011;
18. Deposition transcript of Mark Jonovich,
19. Taser download record for Taser X00-165116 for 06/24/10 - 06/26/10;
20. Plaintiff's Exhibit 10;
21. Diagram 003154;
22. Diagram 003156;
23. Plaintiff's Exhibit 24;
24. Plaintiff's Exhibit 26;
25. Plaintiff's Exhibit 30;
26. Picture 003728;
27. Picture 003729;
28. Plaintiff's Exhibit 31;
29. Picture 000077;
30. Picture 000069;
31. Picture 000064;
32. Plaintiff's Exhibit 32;
33. Picture 000065;
34. Curriculum Vitae for Menashe Waxman;
35. Preliminary Export Report for Menashe Waxman, M.D.; and
36. Expert Report of Michael D. Layman, PH.D.

----- BRIEF OVERVIEW OF EVENTS -----

On Saturday, June 26, 2010, at approximately 1:33 a.m., Painesville Police Officers Robert Soto and Jason Hughes were dispatched to "a disturbance outside of 270 South St. Clair Street. They believed there was a fight going on." (Soto depo. pg. 43, lines 23-25) Officer Soto arrived first and spoke with Brandy McElroy in the area of the driveway. In his deposition, Officer Soto said that he could "hear people inside of the house yelling." When Officer Hughes arrived, both officers walked up the steps to the apartment where the yelling was originating from and knocked on the door.

Mr. Nall and Ms. Carlucci answered the door. Mr. Nall was shirtless and shoeless, wearing only a pair of jeans. The officers explained to Mr. Nall and Ms. Carlucci that they were there in response to a disturbance call. Ms. Carlucci told the officers that "the person that was involved in the altercation had left and there was going to be no issues for the night." (Soto depo. pg. 45, lines 19-21) While the officers were

talking with Ms. Carlucci, Mr. Nall was trying to talk over Ms. Carlucci, saying that they had done nothing wrong. Officer Soto said that Mr. Nall's voice "appeared to be hoarse, he was breathing heavy, he was sweating. It appeared to me maybe he was involved in the altercation." (Soto depo. pg. 45, line 24 - pg. 46 line 1)

After some discussion, Mr. Nall gave the Painesville officers his social security number and they were able to identify Mr. Nall and learn that he had no wants or warrants. The officers then tried to take the ID that Ms. Carlucci was holding. Mr. Nall pushed the ID back toward Ms. Carlucci and told her that she did not have to be identified. The officers explained to Mr. Nall that they did need to see her ID and that he would be arrested for disorderly conduct if he continued yelling at her and interfering.

After their discussion with Mr. Nall and Ms. Carlucci and returning her ID, the Painesville Officers walked back down the wooden staircase that led to the apartment. The officers remained in the driveway and heard people yelling in the apartment above. The yelling continued and neighbors from around the area started coming out of their dwellings. The officers decided that they needed to go back to the apartment and either cite or arrest the violators.

When the officers made it to the bottom of the stairs, they encountered a female, later identified as Michelle Prochaska. Officer Hughes spoke directly to her and Officer Soto overheard the conversation. In his deposition, Officer Hughes stated, "her exact words to us when she got to the bottom of the stairs was, you've got to get in there. She stated that Mr. Nall was out of control, that he had threatened to kill everybody in the apartment, and he said he threatened to kill the police if they came back." (Hughes depo. pg 69, line 24 - pg. 70, line 3)." Officer Hughes further said, "Miss Prochaska then stated that Mr. Nall had thrown her on the couch and at some point in the altercation with him her necklace had been ripped off, including the locket." (Hughes depo. pg. 70, lines 4-7)

Both Officer Soto and Officer Hughes decided they needed to take Mr. Nall into custody. For the safety of all parties, it was decided that the officers would ask Mr. Nall to come downstairs into the driveway area prior to affecting the arrest. Officer Hughes was to act as the contact officer and Officer Soto was to be the cover officer. Mr. Nall was asked to step outside and come downstairs with the officers to which he refused to comply. He started to back up from the doorway where he had been standing. Mr. Nall was told again to come outside and again he replied that he was not coming. At that time, Officer Soto told Mr. Nall that he was under arrest.

Both officers could see that Mr. Nall was clenching his fists and he said to the officers, "if I'm going with you you're going to have come in and get me." (Hughes depo. pg. 72, lines 20-21) At that time Officer Hughes saw Mr. Nall make a motion with his right hand that indicated to the officer Mr. Nall was signaling the officers to come and get him. Officer Soto then pointed his Taser at Mr. Nall, told him that he was under arrest and to get on the ground or he would be tased. Officer Hughes said, "Mr. Nall decided to make a very, very quick move and try to get out of the doorway and what turned out to be trying to get into the living room,." (Hughes depo. Pg. 74, lines 8-11)

Officer Soto said that after told Mr. Nall to get on the ground, "he pulls on his belt and he's giving me the motion, you're going to have to come get me." (Soto depo. pg. 57, lines 15-18) Officer Soto said that at that point, Mr. Nall reached over and shut the door on the officers. Officer Soto was able to put his foot in the door before it closed and the door, "almost sprung off my foot, he juts behind the door. Just before he goes behind the door, I was able to get a shot off, and then I lost sight of him." (Soto depo. pg. 63, lines 10-13)

Officer Soto believes that he was approximately four feet away from Mr. Nall when he fired. When the officer fired his Taser, he was standing outside of the apartment on the landing. Officer Soto said, "At that point I lost sight of him, unknown if I even got him or not." (Soto depo. pg. 64, lines 3-4)

Officer Soto remembers stepping into the apartment and taking cover behind a wall. He did not know if there were any weapons in the residence or who was in the apartment. Officer Soto said that he was just trying to cover himself and that Officer Hughes was behind him. Officer Soto said, "In order for us to get into that living room, we had to shut the door. There was no just going in, you had to shut the door." (Soto depo. pg. 64, lines 10-13)

Officer Soto said that they had to look to make sure that the people in the apartment had no visible weapons. As Officer Soto went into the living room, he saw that Mr. Nall was basically in a pushup position, with his arms extended, getting up. Officer Soto moved forward and tried to push Mr. Nall down, grab an arm and get it out into a control position. When Officer Soto knelt down to do this he became tangled in the Taser wires and felt a jolt of electricity.

At that time, Officer Soto realized that he was still depressing the trigger of the Taser, causing it to still remain on. Officer Soto immediately stepped back and released the trigger of the Taser, stopping the cycle. The time frame of shooting the Taser, entering the apartment, taking cover behind a wall, visibly clearing the living room, moving to Mr. Nall and

attempting to get him onto the floor took twenty-one seconds. We know this because that was the time registered on Officer Soto when his Taser was later downloaded.

Officer Soto could see that Ms. Carlucci was standing up and heard her yelling. Officer Hughes had to focus his attention on her and the others to make sure that they did not interject themselves into the confrontation. Around that time Officer Collins arrived and assisted Officer Soto in trying to secure Mr. Nall. In his deposition, Officer Collins stated, "I observed Hughes and Soto struggling to get handcuffs on the subject lying down, which was Mr. Nall. And Jason had one on and I reached over and I grabbed the left side, his arm, and started to pull it out and giving my verbal commands, and he pulled back and then I pulled back more and put the hands back behind his back so we could get him cuffed." (Collins depo. pg. 40, lines 6-13)

In his deposition, Officer Hughes said that by the time he got to Mr. Nall, he was on the ground. He did not see Mr. Nall in the push-up position described by Officer Soto. Officer Hughes yelled for Mr. Nall to stop resisting and to put his hands behind his back. Officer Hughes stated, "I was pulling on his arm. I initially was trying to pull on his left arm and it was - there was a fair amount of resistance." (Hughes depo. pg. 31, lines 21-24) Officer Hughes said that he was solely focused on getting Mr. Nall's hands and the officer did not experience any electrical current.

Officer Hughes said there was resistance in Mr. Nall's arms but the rest of his body was pretty much lying on the ground. "The entire time that myself and Officer Collins were trying to pull his hands behind his back there was a continued resistance with his arms. It never - it never felt like it really let up." (Hughes depo. pg. 35, lines 1-4) The officer said that Ms. Carlucci was in close proximity to where he and Officer Soto were so he was unable to focus his attention on Mr. Nall.

Officer Soto said, "Officer Collins arrived to assist in the cuffing because Officer Hughes then was able to start cuffing Nall, but he was still resisting. Once I was able to deactivate, I gave a drive stun. That was ineffective as well." (Soto depo. pg. 66, lines 19-23) Shortly after this, Officer Hughes and Officer Collins were able to place the handcuffs on Mr. Nall. Once Mr. Nall was handcuffed, all response control measures by the police stopped.

Officer Hughes then had to leave the other officers to deal with Ms. Carlucci who was standing up and yelling at the officers. Because of the concern about Ms. Carlucci as well as the other people in the living room that were yelling, Officer Soto said that they wanted to get Mr. Nall out of the apartment

immediately. Officer Soto said, "We kept telling him to sit up and cooperate and walk out, because we could feel him pulling down in the living room." (Soto depo. pg. 81, lines 8-10)

Officer

Officer Soto stated that Mr. Nall was pulling down, which the officer perceived as passively resisting. The officer thought that Mr. Nall was just going to force the officers to pick him up and carry him from the apartment. Officer Soto said, "He wasn't talking to us. He wasn't doing anything. I believe I saw gurgle - or foam out of his mouth once we were able to sit him up. (Soto depo. pg. 81. Lines 3-5)

Officer Collins said that he too was talking with Mr. Nall, trying to get him to stand up. Officer Collin's assessment of Mr. Nall was the same as that of Officer Soto. Officer Collins said, "He wouldn't get up. Passive/resistance is what he was like. He was just kind of, I'm not going to get up, pulling downward." (Collins depo. pg. 40, lines 21-24)

Officer Collins said that when he started Mr. Nall toward the door, the officer noticed Mr. Nall's breathing changed. Officer Collins said, "It was more of a gurgling sound and I realized we needed to get him out in fresh air and away from the problems inside." (Collins depo. pg. 41, lines 2-4). It was around that time that Officer Collins saw that Mr. Nall was foaming at the mouth.

Officer Soto and Officer Collins held Mr. Nall under the arms and removed him from the apartment. Officer Soto does not remember if Mr. Nall helped any in leaving the apartment or not. Officer Collins had to throw some trash and empty beer cans off of the porch landing to make room for Mr. Nall to sit. Officer Soto said, "Officer Collins moved some items that were on there, threw over and sat him upright and I look and I see he's unresponsive." (Soto depo. pg. 83, line 25 - pg. 84 line 3) Officer Soto was asked if there was a time when he called for medics and his reply was, "The minute we noticed he wasn't responding." (Soto depo. pg. 85, line 19)

Officer Soto said that he sat Mr. Nall upright. The officer said that Mr. Nall would not communicate but, "He was breathing. We could see his stomach moving and his eyes were open. We just - it was gurgling and I go, Mr. Nall, you know, wake up, get up, you know, wake up. And that's what I observed." (Soto depo. pg. 84, lines 8-12) After the medics were called, Officer Soto said that they removed Mr. Nall's handcuffs and a short time later, Officer Soto removed the Taser probes.

Officer Collins said that once Mr. Nall was on the landing, "Then I was able to look around, I saw he was foaming at the mouth. I immediately checked for a carotid pulse right here in

the neck, I had a pulse. I could see that his chest was rising and falling. And I noticed he was kind of like opening his eyes and shutting his eyes. At that time I called for a squad for the scene and I kept him upright with his airway so that he could breathe so his neck wasn't forward or too far back and kept his body in position. And I rubbed his sternum and talked to him, trying to get him -keep him attentive." (Collins depo. pg. 41, lines 12-23)

The records indicate that it was approximately four minutes and twenty-one seconds from the time that the squad was dispatched until the time they reached Mr. Nall. At approximately 1:56 am, Mark Jonovich, an EMT paramedic first assessed Mr. Nall. EMT Jonovich determined that Mr. Nall was unresponsive, he did not have an obstructed airway, he did not have labored or difficulty breathing but did have irregular respirations and he had a pulse. Other medics worked on Mr. Nall and he was continually assessed and monitored.

At 2:01, Mr. Nall went into full arrest. At that time the medics began using an oxygen bag valve mask and CPR. At 2:02 and 2:03, medics started applying paddles and patches on for the defibrillation and at 2:03 Mr. Nall was intubated. There was a defibrillation done at 2:09 and at 2:11. Medications were administered at various time intervals during this time frame.

At 2:14, Naloxone was administered. In his deposition, EMT Jonovich was asked what is Naloxone? He replied, "To combat - it's one of our potions when we have PEA to combat a possible unknown condition for an altered mental state or unresponsiveness. It's to combat the drug overdose if it's legal or illegal narcotics and things like that." (Jonovich depo. pg. 66, lines 8-12) Very shortly after Naloxone (Narcan) was administered, Mr. Nall's pulse returned. Mr. Nall was stabilized by the medics who continued to monitor Mr. Nall and transport him to the hospital.

--- STATEMENT OF OPINIONS ---

1. When the Painesville officers received a call for service they had a duty to respond as they did.
2. The Painesville Officers had probable cause to arrest Mr. Nall for numerous violations of law.
3. After the Painesville Officers informed Mr. Nall that he was under arrest, they were correct in entering the apartment to affect Mr. Nall's arrest.
4. The use of the Taser by Officer Soto and the responses of

the other Painesville Officers in relation to the actions demonstrated by Mr. Nall complied with their departmental policy and the training that all Ohio Officers receive.

5. In arrest situations such as the one in question, the Taser is the best tactical response which offers a high propensity of establishing control while offering a low propensity of causing injury for both the officers and the subject being arrested.
6. The Painesville Officers de-escalated appropriately once Mr. Nall was under control.
7. The follow-up care given to Mr. Nall by the Painesville Officers complied with national training and operational guidelines.
8. Considering the totality of the circumstances, Ms. Nall's turbulent actions obstructed the Painesville Officers during the arrest of Mr. Nall and would have caused any reasonable officer to believe that probable cause existed to arrest Ms. Nall.

----- BASIS FOR OPINIONS -----

1. The Painesville Officers have taken an oath to uphold and enforce the laws and ordinances of the United States, the State of Ohio and the City of Painesville. A disturbance call where it is believed that a fight is going on is considered a call of risk for any officers who respond. Placing themselves in harm's way, the Painesville officers disregarded their personal wellbeing and responded. This is their job and what their profession demands. It is my opinion that when the Painesville officers received a call for service they had a duty to respond as they did.

2. The Painesville Officers were dispatched to a disturbance call where it was believed that subjects were fighting. When they arrived, they spoke with people in the area and witnessed loud noise and yelling coming from the apartment in question. The officers went upstairs and spoke personally to Mr. Nall and Ms. Carlucci. The officers found that Mr. Nall was shirtless and shoeless, wearing only a pair of jeans. The officers explained to Mr. Nall and Ms. Carlucci that they were there in response to a disturbance call. While the officers were talking with Ms. Carlucci, Mr. Nall was trying to talk over Ms. Carlucci, saying that they had done nothing wrong. Officer Soto

said that Mr. Nall's voice "appeared to be hoarse, he was breathing heavy, he was sweating. It appeared to me maybe he was involved in the altercation." (Soto depo. pg. 45, line 24 - pg. 46 line 1)

Ms. Carlucci told the officers that "the person that was involved in the altercation had left and there was going to be no issues for the night." (Soto depo. pg. 45, lines 19-21) We now know that Ms. Carlucci had not told the officers the truth. In her deposition, Ms. Nall stated:

A. "I think AJ and Jeron were still in the attic.

Q. What is the attic?

A. David was turning—after I got Jeron in the house after the argument, that's where they went." (Rebecca Nall depo. pg. 71, lines 22-25)

The Painesville Officers informed Mr. Nall why they were there, what needed to happen for the officers not to have to come back and the consequences if the officers were forced to return. Mr. Nall had already obstructed the officers in their investigation and had been warned about it. The officers also believed that Mr. Nall might have been involved in a confrontation because he was sweating, breathing hard and sounded hoarse.

At the conclusion of their contact with Mr. Nall and Ms. Carlucci, the officers went downstairs, stood in the driveway and listened. They heard people yelling in the apartment above and as the yelling continued, neighbors from around the area started coming out of their dwellings. The officers were told by an unidentified person that there had been an altercation involving people from the upstairs apartment previously. At this point the Painesville Officers had disorderly conduct after a warning, which by Ohio Revised Code an officer may arrest for. The officers decided that they needed to go back to the apartment and either cite or arrest the violators.

When the officers were returning to the stairs, they encountered a female, later identified as Michelle Prochaska. In his deposition, Officer Hughes stated, "her exact words to us when she got to the bottom of the stairs was, you've got to get in there. She stated that Mr. Nall was out of control, that he had threatened to kill everybody in the apartment, and he said he threatened to kill the police if they came back." (Hughes depo. pg 69, line 24 - pg. 70, line 3)." Officer Hughes further said, "Miss Prochaska then stated that Mr. Nall had thrown her on the couch and at some point in the altercation with him her necklace had been ripped off, including the locket." (Hughes depo. pg. 70, lines 4-7) At that point both Officer Soto and Officer Hughes decided they needed to take Mr. Nall into custody.

The violations that the Painesville officers had in addition to disorderly conduct after a warning were assault and possibly a number of counts of menacing. Based on the actions Mr. Nall demonstrated after being informed that he was under arrest, the officers also could have charged Mr. Nall with resisting.

The fact that Mr. Nall was not ultimately charged for all of his violations is not uncommon. The Painesville Officers knew that Mr. Nall was injured in the process of arrest. Based on Mr. Nall's physical condition, it would serve no purpose to pile on charges. Mr. Nall was charged for disorderly conduct, the original violation he committed in the officers presence.

XXXX Mr. Nall was not found guilty of the charge of disorderly conduct. That in no way means the officers did not have probable cause at the time Mr. Nall was informed that he was under arrest. A training aid that I used in the classes that I taught at the Ohio Peace Officer Training Academy and still use in my current classes is called the Probable Cause Triangle, a copy of which is included with the exhibits.

The burden of proof in a criminal case is "beyond a reasonable doubt." This is a very high standard and is listed on the Probable Cause Triangle just below "Absolute Proof" which would offer "Absolute Certainty." On page 9 of Plaintiff's expert Layman opinion paper, he gives the IACP definition of probable cause, "The existence of circumstances that would lead a reasonably prudent officer to believe that a person had committed a criminal offence." Circumstances that would lead an officer to believe are a much lower standard than proof beyond a reasonable doubt. The case, *Illinois v. Gates*, 462 U.S. 213, 238, 103S.Ct. 21317, 2332, 76 L.Ed. 2d 527, 548 (1983), lowered the threshold of probable cause by ruling that a "substantial chance" or a "fair probability" of criminal activity could establish probable cause.

After considering the situation, both of the Painesville Officers decided that they were going to arrest Mr. Nall. They had personally witnessed disorderly conduct after a warning, they had a lady speaking with them who stated that she was assaulted and threatened. The same lady said that Mr. Nall was threatening everyone in the apartment and that he stated that he would kill the police if they returned.

I believe that any reasonable officer would have felt that there existed circumstances that would lead a reasonably prudent officer to believe that a Mr. Nall had committed a criminal offence. Any reasonable officer would believe that there was a substantial chance or a fair probability that Mr. Nall had committed violations of law. It is my opinion that the

Painesville Officers had probable cause to arrest Mr. Nall for numerous violations of law.

3. It has been argued that the Painesville Officers were incorrect to enter the apartment to affect the arrest on Mr. Nall, stating that the officers did not have a warrant and there were no exigent circumstances. Exigent circumstances, means circumstances or events that call for immediate action. Officer Soto was within a few feet of Mr. Nall during their conversation and when the officer informed Mr. Nall that he was under arrest. Mr. Nall tried to close the door but was never successful. Officer Soto was actively involved in the arrest process and was not required to abandon that process just because there was a doorjamb between Mr. Nall and the officer.

The second time the officers went to the apartment, they were not just there for a disorderly conduct at that time. They had a statement from Ms. Prochaska that she had been assaulted. The officers had been informed that Mr. Nall had threatened to kill everyone in the apartment. They were told that Mr. Nall had threatened to kill the police if they returned. The officers were also told, "you've got to get in there. She stated that Mr. Nall was out of control." (Hughes depo. pg. 69, line 25 - pg. 70, line 1)

The officers also heard noises coming from the apartment that they believed were consistent with someone possibly being assaulted and the officers had not been able to confirm the wellbeing of the people inside of the apartment. We now know that within that small apartment, there was Mr. Nall, Rebecca Nall, three other females and two other subjects hiding in the attic. In his deposition, Officer Hughes stated, "While myself and Officer Soto were standing in the driveway waiting before we approached the apartment the second time, I heard a female scream, what sounded to be like a female voice, a high-pitch scream. Shortly thereafter is when I was watching that window I observed a female and what appeared to be a female with very short length hair, inside that window. It appeared they were having a very heated discussion about what was going on inside the apartment." (Hughes depo. pg. 68, lines 15-24)

The totality of the circumstances would have made any reasonable officer believe that there were exigent circumstances that would necessitate entry into that apartment. It is my opinion that after the Painesville Officers informed Mr. Nall that he was under arrest, they were correct in entering the apartment to affect Mr. Nall's arrest.

4. Millions of federal research dollars have been spent over the past few years to better understand how police use and

implement force. This cost outlay actually has produced little useful information to explain the dynamics of police and citizen confrontations. One reason for this failure is that the number of encounters in which law enforcement officers use force is rare. It is believed that force is used in fewer than 3 percent of all police-citizen encounters (Friedrich, 1997; Fife, 1995; Garner, 1995; Klockers, 1995; Reiss, 1967, Worden, 1995).

The *Police-Public Contact Survey*, of 1996 found that out of the estimated 45 million face-to-face contacts between police and the public, only 1 percent of those contacts resulted in force being threatened or used by the police (Greenfield, Langan, and Smith, 1997). The International Association of Chiefs of Police, in *Police Use of Force in America*, p. I-ii, (2001) found that nationwide, police officers use force at a rate of 3.61 times per 10,000 calls for service to the public. Put another way, police officers do not use force 99.9639% of the time. The U.S. Department of Justice, in *Use of Deadly Force in America*, p. vii, (Oct. 1999) stated that in only a fraction of all force cases - about 0.2% - do police officers use deadly force.

The standard that all law enforcement officers must follow in the use of any type of force against a citizen is derived from the Supreme Court case *Graham v. Connor*, 490 U.S. 386, 104 L.Ed 2d 443, 190 S.Ct. 1865 (1989). As the Supreme Court stated, "all claims that law enforcement officers have used excessive force - deadly or not- in the course of an arrest, investigatory stop, or other 'seizure' of a free citizen should be analyzed under the Fourth Amendment and its 'reasonableness' approach.

The 'reasonableness' of a particular use of force must be judged from the perspective of a reasonable officer on the scene, rather than with the 20/20 vision of hindsight. The calculus of reasonableness must embody an allowance for the fact that police officers are often forced to make split-second judgments, in circumstances that are tense, uncertain and rapidly evolving about the amount of force that is necessary in a particular situation."

For the past twenty years, I have conducted a series of national research projects to determine what law enforcement officers, corrections officers and civilians consider to be reasonable responses to the types of resistance, aggression and assaults officers must face. I have conducted another similar study with the U.S. Justice Department, National Institute of Justice on this topic. Most recently I have completed a research project involving the Ohio Department of Youth services in which we surveyed juvenile correction officers, juvenile probation and parole officers, law enforcement officers, and

juvenile judges in order to ascertain what they felt were reasonable responses to resistance, aggression and assault by juvenile offenders.

The end result of these research projects is the Action - Response Continuum, a copy of which is included in the exhibits. This continuum has become the recommended model for Basic Peace Officer Training, Advanced Peace Officer Training, Corrections Training, Private Security Training, and Bailiffs Training for the State of Ohio. Numerous Police departments and Sheriff's Offices throughout the United States also use it. It can also be found in the West Virginia State Police Policies and Procedures and is trained in their Basic Training Academies. The Ohio Attorney General's Office has published my research in a book titled, *USE OF FORCE, DECISION MAKING AND LEGAL PRECEDENCE*. The book has been distributed throughout Ohio, as well as the rest of the nation.

The research projects that I have conducted have a subject total of approximately sixty thousand respondents. Approximately fifty thousand respondents were from law enforcement and corrections. The remainder is from civilians, the people who law enforcement officers are sworn to protect and serve. All of the Defensive Tactics/Subject Control training that I do or have done is based on this research. I will use the Action - Response Continuum to analyze the actions of Mr. Nall and the responses of the Painesville Officers.

Mr. Nall's refusal to comply with the officer's commands after being told that he was under arrest placed him in the BLUE area of the continuum. Both Officer Soto and Officer Hughes saw Mr. Nall step back, clench his fist and make motions indicating to the officers that they would have to come in and take him. This action on the part of Mr. Nall placed him in the ORANGE area of the continuum.

Officer Soto did not immediately physically respond to Mr. Nall's threatening action. Officer Soto established what is referred to as a context condition. Officer Soto showed Mr. Nall the Taser and told him that he would be tased if he did not comply. Mr. Nall decided to slam the door on the officer. Officer Soto was able to place his foot in the door to prevent it from closing. The door hit the officer's foot and sprang open.

Officer Hughes said, "Mr. Nall decided to make a very, very quick move and try to get out of the doorway and what turned out to be trying to get into the living room,." (Hughes depo. Pg. 74, lines 8-11) Officer Soto saw Mr. Nall dart across the door opening. The officers had been told before they went up the stairs to the apartment the second time that Mr. Nall had said he would kill the police if they came back. The officers did

not know if any weapons were in the apartment and if Mr. Nall was going to get a weapon. The officers did know that an immediate response was necessary for the safety of all parties.

The clenching of fists and motions made by Mr. Nall placed him in the ORANGE area of the continuum. The threat of his possibly running to get a weapon made things border on the RED area of the continuum. The response by Officer Soto was to fire his Taser, which is a response from the YELLOW area of the continuum.

The point is continually brought up that Taser International changed their targeting model which no longer names the upper chest a preferred area. Taser does not say that the chest is no longer a target area, just not a preferred area. If both of the probes are in or in close proximity to the chest area, there is less chance of achieving the muscular lockup that Tasers are known for. Another reason is that no matter what substances are in the subject's body, no matter how poor his/her physical and/or medical condition, if the probes are anywhere near the chest, there is an increased chance that the Taser will receive at least some of the blame if the subject does die. The exact wording in Taser Bulletin 15 states, "By simply lowering the preferred target zone by a few inches to lower center mass, the goal of achieving Neuro Muscular Incapacitation (NMI) can be achieved more effectively while also improving risk management."

In this situation, Officer Soto did not have time to purposefully target the chest area. Mr. Nall's fleeing presented Officer Soto with a rapidly moving target. The officer did not have time to acquire target acquisition and have a clear sight picture. Officer Soto deployed his Taser in the direction of Mr. Nall and has consistently said that he had no idea if the probes hit Mr. Nall anywhere at all.

The Painesville Officers lost sight of Mr. Nall. The Officers had to enter the apartment one at a time because they had to partially close the front door to get into the room where Mr. Nall had run toward. Officer Soto stated that he stepped behind a wall for cover because he did not know if there were any weapons or who was in the apartment. When Officer Soto saw Mr. Nall, he felt that he had either missed with the Taser or that it was ineffective because Mr. Nall was in the process of getting up off of the floor.

Officer Soto moved forward to try and keep Mr. Nall from getting up. At that point Officer Soto touched the Taser wires and was shocked. With that shock, he realized that the Taser was still active and he released the trigger, which stopped the Taser cycle. Officer Soto was surprised by this because it was his belief that the Taser would cycle for only five seconds even if the Taser trigger remained depressed.

After starting work on this case, I have asked a number of officers in my department as well as surrounding departments what would happen if the Taser trigger remained depressed. Approximately one-half of the officers believed as Officer Soto did, that the Taser would stop after five seconds even if the trigger remained depressed. Apparently this is a common problem. There are no test questions on the older versions of the Taser written tests regarding this issue. The newer and current Taser test does have a question referring to the length of the Taser cycle if the trigger mechanism is held.

Officer Soto has repeatedly stated that he believed the Taser cycle would stop after five seconds even if the trigger remains depressed. Officer Soto would not have been able to hear the Taser cycling with the noise from the apartment and the quietness of a Taser cycle with a good circuit. The digital readout on the back of the Taser starts at 5 (meaning 5 seconds) and counts back to 00, corresponding to the 5-second Taser cycle. If the trigger mechanism is held beyond five seconds, there is no indication or notification of the actual time of the cycle visible in the Taser readout. Even if there had been a visible total time indicator on the back of the Taser it is doubtful that Officer Soto would have noticed it considering the totality of the circumstances.

Officer Hughes has been criticized because he did not intervene and stop the Taser cycle. We are instructed by the Court that we must put ourselves in the footprints of the officers at the time of the incident and base our decisions on the appropriateness of their actions only on the facts and circumstances that they knew at that instant. Officer Hughes witnessed the threatening behavior that Mr. Nall demonstrated. He heard the Taser fired by Officer Soto, but like Officer Soto, Officer Hughes had no idea if the probes made contact with Mr. Nall at all.

Officer Hughes entered the apartment after Officer Soto. It is well documented that there was a lot of loud noise emanating from the apartment as well as the commands being shouted by the entering officers. From the position of Mr. Nall, even when Officer Hughes could see Mr. Nall, the officer could not see the Taser probes and from Mr. Nall's behavior, it appeared that the Taser was having little or no effect on Mr. Nall. We now know that Mr. Nall was struck with both Taser probes, so a good circuit would have been created.

That being the case, the Taser would be very quiet and it is doubtful that the Painesville Officers would have been able to hear anything from the Taser with all of the noise in the apartment. Witnessing the behavior of Mr. Nall prior to the officers entering the apartment, the quietness of the Taser when

there is a good circuit, the loud noises the officers were subjected to and the behavior of Mr. Nall when the officers got to him, Officer Hughes would have been given no reason to intervene in any way other than trying to control Mr. Nall as Officer Hughes did.

Officer Hughes, followed by Officer Collins worked together to try and maneuver Mr. Nall into a handcuffing position. Basically the officers tried to pull Mr. Nall's hands behind his back and Mr. Nall tried to prevent them from accomplishing their task. Mr. Nall's actions placed him in the GREEN area of the continuum and the officer's responses were from the BLUE area of the continuum.

There is no allegation or evidence in the records that indicate Mr. Nall was struck by any officer or that any additional control measures were used against him. It is my opinion that the use of the Taser by Officer Soto and the responses of the other Painesville Officers in relation to the actions demonstrated by Mr. Nall complied with their departmental policy and the training that all Ohio Officers receive.

5. It is my opinion that in arrest situations such as the one in question, the Taser is the best tactical response which offers a high propensity of establishing control while offering a low propensity of causing injury for both the officers and the subject being arrested. In the exhibits with this paper, I am including a release from Taser International, Inc. on September 8, 2011. The releases states

- More than 600,000 Taser ECDs are used by law enforcement worldwide;
- 107 countries deploy Taser ECDs;
- ECDs are deployed roughly once every two years in the field based on reported usage patterns;
- Taser ECDs have been used in approximately 1.4 million incidents;
- The usage equates to roughly 2.3 times for each Taser ECD fielded since 1999;
- 5.4% of the 1.4 million field incidents of Taser deployments equates to the number of people saved from serious injury or death;
- Taser ECDs are deployed more than 900 times each day worldwide.

These statistics offer a glimpse of the wide acceptance of Tasers worldwide throughout the law enforcement and corrections profession.

Included in the exhibits is an example of an e-mail sent out from Taser International on September 19, 2011. E-mails such as these, training bulletins, notices of Taser Instructor courses, notices about Taser sales and new research about Tasers are e-mailed sometimes on a daily and certainly multiple times a week. I certainly am more interested in this topic than the average officers. Most of the e-mails I scan and delete. The average officer would not spend time studying the frequent Taser e-mails.

Officer Soto had not seen the notification by Taser altering the previously taught preferred target areas. Had Officer Soto seen that article it would not have made any difference in the confrontation with Mr. Nall. Taser did not tell officers not to shoot at the chest. They recommended that officers not target the chest area because if the probe spread is close together, it lessens the effectiveness of the Taser. Also, if the chest area is not tased, it eliminates many of the allegations such as those being brought against the Painesville Officers. As stated previously, it must be remembered that Officer Soto did not aim at the chest, did not know that the probes hit the chest and in fact did not know that the Taser probes struck Mr. Nall anywhere at all.

Also in the exhibits is an article from the Force Science Research Center about a recent study in Canada titled, "New Study Ranks Risk Of Injury From 5 major Force Options." Anytime there is a confrontation between law enforcement and the subjects they are attempting to arrest, there is an inherent risk of injury to all parties involved. This study examines the relative risk to officers and the subjects they are attempting to arrest using, empty hand controls techniques, batons, OC Spray (pepper gas), conducted energy weapons (Tasers) and lateral vascular neck restraints.

The least injurious control measure of the ones listed above was OC spray. In the case in question, pepper gas would certainly have been a reasonable response but a tactically poor decision. With Mr. Nall fleeing out of the officer's sight, it would have been very difficult at best to contaminate him. The spray would have also contaminated all other parties in the apartment and the officers who entered to control Mr. Nall.

Batons were found to have the greatest rate of injury and a greater rate of higher-level injury than the other options studied. When Mr. Nall stepped back and clenched his fists, a baton response would have been reasonable if Mr. Nall had attempted to strike the officers. Batons were not practical or necessary when Mr. Nall fled.

Empty hand control options would have been reasonable, but were not possible until the Painesville Officers caught up with

Mr. Nall. The study found that empty hand control options also ranked high for more serious injuries to both officers and the subjects who are being arrested. Lateral vascular neck restraints were found to be the second safest force option but again were not practical or necessary in this situation.

Conductive energy weapons (Tasers) also scored high in safety for both suspects and officers.

Butler and Hall, the individuals who conducted the study stated, "No use of force technique available to police officers can be considered safe. In the dictionary sense that it is free from harm or secure from threat of danger. Every use of force encounter between the police and a citizen carries with it the possibility for injury for one or all of the participants, however unexpected that injury might be. The best that can be hoped for is an appropriate, proportional balance between the degree of risk of harm and the resistance faced by police that requires the use of force."

I am also including a May, 2011 study from the U.S. Department of Justice, National Institute of Justice titled, Police Use of Force, Tasers and Other Less-Lethal Weapons. The study examined injuries that occur to law enforcement officers and citizens during use-of-force events.

"The study found that when officers used force, injury rates to citizens ranged from 17 to 64 percent, depending on the agency, while officer injury rates ranged from 10 to 20 percent. Most injuries involved minor bruises, strains and abrasions. The study's most significant finding is that, while results were not uniform across all agencies, the use of pepper spray and CEDs can significantly reduce injuries to suspects and the use of CEDs can decrease injuries to officers."

One factor looked at in this study was if research indicated that the use of CEDs could result in ventricular fibrillation. Important aspects of the study are quoted below. "Several studies showed that standard shocks that lasted five to 15 seconds did not induce ventricular fibrillation of the heart. Higher discharges, 15 to 20 times the standard, or those of longer duration - two 40-second exposures - induced fibrillation or increased heart rhythm in some pigs. In addition, longer exposures led to ventricular fibrillation-induced death in three pigs."

The study went on to say, "Controlled studies involving healthy human subjects (often law enforcement trainees) found that subjects experienced significant increases in heart rates following exposure, but none experienced ventricular fibrillation." Caution was advised when dealing with "small children, those with diseased hearts, the elderly, those who are pregnant and other at-risk people."

Advice from the study stated, "A suspect's underlying medical conditions may be responsible for behavior that leads law enforcement officers to subdue him or her. Sometimes this includes CED use. Abnormal mental states in a combative or resistive subject, sometimes called "excited delirium" may be associated with a risk of sudden death. This should be treated as a medical emergency."

NIJ gave recommendations on the placement of pepper spray and CEDs on a use-of-force continuum. "People rarely die after being pepper sprayed or shocked with a Taser. However, if injury reduction is the primary goal, agencies that allow use of these less-lethal weapons are clearly at an advantage. Both weapons prevent or minimize the physical struggles that are likely to injure officers and suspects alike. Although both cause pain, they reduce injuries and according to current medical research, death or serious harm associated with their use is rare. In that sense, both are safe and similarly effective at reducing injuries. Both should be allowed as possible responses to defensive or higher levels of suspect resistance. This recommendation is supported by the findings and is now followed by most agencies that responded to the national survey."

The last article I am including as an exhibit is a May, 2011 study from the U.S. Department of Justice, National Institute of Justice Special Report titled, Study of Deaths Following Electro Muscular Disruption. The article is in excess of sixty pages so I am also including seven pages of key points that I have put into a condensed form. I have included the page number from the original NIJ Special Report to make it easy for anyone to check the accuracy of the condensed materials. Some of the materials that have been presented on behalf of the Plaintiff that cite some negative effects by the Taser are actually studies that were done on pigs. None of the studies on human subjects have reproduced any of those negative effects.

Any responsible parties examining force issues have agreed that a subject who resists arrest increases the risk of injury to both the subject as well as law enforcement. The best that can be hoped for is to manage the risk to both parties. A major factor this NIJ study found was, "the risk of death in a CED-related use-of-force incident is less than 0.25 percent, and it is reasonable to conclude that CEDs do not cause or contribute to death in the large majority of those cases." (pg. viii)

In comparing CED to other control options the study stated, "It should be noted that arrestees who are involved in use-of-force incidents are by nature at higher risk for serious complications and death relative to the overall population. These individuals are more likely to be drug-intoxicated, be

mentally ill or have serious underlying medical conditions. There are more than 600 arrest-related deaths in the United States each year and roughly 1 million incidents in which police use or threaten force. Nonetheless, the CED is cited as a causative or contributory factor in very few arrest-related deaths each year. In this context, the relative risk of CED deployments appears to be lower than other use-of-force options."

"There is no conclusive medical evidence --- that indicates a high risk of serious injury or death from the direct or indirect cardiovascular or metabolic effects of short term CED exposure in healthy, normal, nonstressed, nonintoxicated persons." (pg. 3) The study goes on to state, "There is currently no medical evidence that CEDs pose a significant risk for induced cardiac dysrhythmia in humans when deployed reasonably." (pg. 9)

There have been a number of allegations about the Taser causing potentially deadly changes in blood chemistry. The study states, "There is a multitude of ECG and cardiac enzyme data in the literature supporting no significant long-term effects on the heart by CED use. Autopsies have not demonstrated evidence of myocardial infarction (heart attack). The available data do not show long-term blood chemistry changes affecting cardiac function. There are some recent data demonstrating significant increase in blood acidity (acidosis) in animal models after CED use. Some research has examined the role of exertion in combination with CED effects. Extreme physical exertion causes an increase in acidosis because of the production of lactate in the muscles. Severe acidosis can cause spontaneous dysrhythmias that would not be a direct effect of CED use. Additionally, severe acidosis can lead to pulseless electrical activity which may be a mechanism of sudden death seen after a prolonged struggle. CED exposure does not appear to worsen the acidosis that is present from exertion alone." (pg. 11)

The sudden deaths of subjects in custody are not just CED problems. The NIJ study states, "Although sudden death occurs in custody with and without the use of CED, the exact mechanism of death in many cases is often not clear. Sometimes, individuals who have been restrained or are in the process of being subdued will stop moving or responding. In many cases, the individual may simply be passively compliant. In some cases, the individual may be experiencing a medical emergency related to acidosis, respiratory compromise, or cardiac arrhythmia. Therefore, the restrained individual should be constantly monitored for responsiveness and general medical condition." (pg. 11)

The change to below the chest as a Taser preferred target area has been discussed previously. This study found, "The panel does recognize that CED use involving the area of the chest in front of the heart is not totally risk-free; current research does not support a substantially increased risk of cardiac dysrhythmia in field situations from anterior chest CED dart penetration." (pg. 13)

It has been alleged that the Taser made it so Mr. Nall was not able to breathe. This study does not support that allegation. "The balance of acid and base in the body is maintained by the respiratory system and the kidneys. These respond to the metabolic demands of the individual. As with rigorous exercise, the CED causes muscle contractions that produce lactate in the blood. Lactate lowers the pH of blood, making it more acidic. Research to date, however, shows that human subjects seem to maintain the ability to breathe during exposure to CED. In fact most evidence suggests hyperventilation with an increase in respiratory rate, tidal volume, and minute ventilation during CED exposure. Direct observation of diaphragmatic movement was seen in one study." (pg. 15)

It has been proposed that acute stress can damage the heart. All aspects of an altercation (verbal altercation, physical struggle or restraint) may create stress. "Medical research suggests that CED deployment during restraint or subdual is not a contributor to stress of a magnitude that separates it from the other stress-inducing components of restraint or subdual." (pg. 19)

Officer Soto has testified that he did not know there was electrical current flowing through the Taser for longer than the normal five second cycle. We know from the Taser download log that the initial Taser deployment was for twenty-one seconds. There is not a great deal of research on prolonged Taser cycles but this study does state, "Although studies on human volunteers undergoing prolonged (greater than 15 second) CED exposure showed statistically significant changes in blood gases, these changes (or any respiratory impairment) appear to have limited clinical significance in these healthy individuals." (pg. 19)

The study further states information regarding prolonged durations of Taser discharges. "There is no evidence in animals that indicates a high risk of injury from a single discharge lasting less than 15 seconds from a Taser X26. Unlike the Taser X26, which requires the user to hold the trigger to maintain discharges longer than five seconds, other CEDs will apply a longer discharge without any intervention from the user. The Taser C2, designed for civilian use, applies a 30-second exposure to a target. Thirty-second exposure to the output of

the Taser C2 CED in swine resulted in significant changes in blood chemistry, although most of the blood changes returned to baseline after the CED discharge ended. However, in one study, 20-to-30-second C2CED application in healthy humans had no significant deleterious effects on their physiology." (pg. 26) The electrical charge from the C2 is the same as that of the X26.

There is no standard definition of "prolonged" CED exposure for either continuous duration or number of multiple interrupted discharges. Review of deaths following CED exposure indicates that some are associated with prolonged or multiple discharges of the CED. By contrast, experiments using healthy human volunteers have found no cardiac dysrhythmias or respiratory dysfunctions following exposures less than 45 seconds. There are no published studies of humans exposed in excess of 45 seconds. Continuous 15 second applications of the X26 to either the back of the chest of "physically exhausted" adult humans (designed to mimic field situations), over a 12-inch anatomic spread encompassing the heart, yield normal electrocardiograms. (pg. 27)

"Most fatalities involving CED use are in people who have other risk factors for sudden death. This is a concern for law enforcement, because a large number of arrestees will have unrecognized clinical states of drug intoxication or pre-existing medical conditions that put them at risk for sudden, unexpected death, regardless of the type of subdual or restraint used." (pg. 32) The conclusion of the study states, "In general, the outcome data are consistent with medical research and this panel's review of deaths following CED deployment. Deployment of CED has a margin of safety as great or greater than most alternatives." (pg. 30)

The Painesville Officers did not ask to go to a disturbance call where it was believed that subjects were fighting. It was not their fault that Mr. Nall did not take their first warning to cease and desist. It was Mr. Nall that assaulted a lady, resisted arrest, threatened officers, was highly intoxicated and had smoked and consumed various illegal controlled substances. The Painesville Officers had a duty to control this situation and due to Mr. Nall's actions, that meant taking him into custody.

By the training and the research that was known by the officers at the time of Mr. Nall's arrest, as well as the body of knowledge known about CEDs today, the Painesville Officers chose the best tactical option available to them. Had the Painesville Officers read the Taser emails and/or had their Taser training the day prior to this incident, there would have been no reason for the officers to believe that the use of a

Taser represented a risk of anything other than minor physical injury. The research on the Taser indicates that it is a safe control option and not a risk of respiratory and/or heart problems to normal humans.

6. Once Mr. Nall was handcuffed and under control, there is no evidence in the record and or allegation that the Painesville Officers mistreated Mr. Nall in any manner. Once the officers were able to handcuff Mr. Nall, no further control measures were used against him. It is my opinion that the Painesville Officers de-escalated appropriately once Mr. Nall was under control.

7. National training and operational guidelines dictate that a subject that is injured or appears to be injured should be given medical treatment. As soon as the Painesville officers realized that Mr. Nall was experiencing distress, they removed him from the apartment and took him outside into the fresh air. The officers took care in sitting Mr. Nall in a position where his breathing would not be compromised.

The squad was immediately called and officers remained with Mr. Nall to continually check on him. The officers attending to Mr. Nall and the paramedics who arrived less than five minutes after being dispatched stated that Mr. Nall was breathing and that he had a heart beat. With breathing and pulse present, officer training would dictate that CPR or rescue breathing should not be given. When the medics arrived and they found breath and pulse, they made the same decision as the officers in terms of rescue breathing and CPR. It is my opinion that the follow-up care given to Mr. Nall by the Painesville Officers complied with national training and operational guidelines.

8. Officer Soto and Hughes were faced with the task of bringing Mr. Nall under control and handcuffing him. Shortly after that, those officers, plus Officer Collins were very busy attempting to aid Mr. Nall who was experiencing some type of a medical emergency. In addition to Mr. Nall, there were numerous other females in the small apartment as well as two unknown subjects hiding in the attic.

In Officer Collin's deposition, he stated that Ms. Nall was yelling at the officers, telling them to "Fuck off." He stated, "I was worried that if anything-if there was four women inside, we hadn't checked any of the rest of the house, so unsure if there was anybody else in there, at that point and then if they came out onto that porch that we were going to have - there was going to be a serious problem." (Collins depo. pg. 67, lines 8-13)

In his deposition, Officer Soto said that after they were able to handcuff Mr. Nall, "At that point Mrs. Carlucci then stands up, and I believe Hughes has to deal with her. I reholstered my - I disengage the cartridge, holstered my taser, and at that point we begin to direct Mr. Nall out of the living room to the outside because at this point we had to get him out of there. We were fighting with Mrs. Carlucci and the other people were yelling. It was - we needed to get out of there with him immediately. Officer Soto said that he was not touched by Ms. Nall and he did not know if Officer Hughes was touched. It is obvious from Officer Soto's statements that he considered Ms. Nall as a threat and that she was hindering the officers from doing what was necessary.

Officer Hughes was the officer that was most directly involved with Ms. Nall. In his deposition, he stated, "During the time when I was trying to get Mr. Nall cuffed, my attention, unfortunately, kept being pulled away from me by the other occupants in the room. (Hughes depo. pg. 35, lines 11-14) Of all the distractions that Officer Hughes had to deal with, Ms. Nall was the greatest obstruction.

Officer Hughes stated, "While dealing with Mr. Nall Miss Carlucci continued to talk to us, yell - telling us to get off of him, pretty much screaming at us. She would occasionally get up off the couch and appeared to - with close proximity to where myself and Officer Soto was at the time. When she would get off the couch, it would draw my attention away. I was unable to focus on effecting the arrest of Mr. Nall because she continued to draw my attention away. I had to - with multiple people in the apartment in order to maintain safety for myself and Officer Soto. And then after Officer Collins arrived, we were able to get Mr. Nall handcuffed." (Hughes depo. pg. 35, line 23 - pg. 36, line 11)

Officer Hughes was not aware of Ms. Nall ever grabbing him. He said that it was his decision to arrest Ms. Nall and to charge her with a crime. Officer Hughes felt that arrest was warranted because of the number of times that he had warned Ms. Nall to sit down and be quiet and because of her actions.

A statement was made to Officer Hughes that alleged that Ms. Nall had not physically interfered with the officer. On page 39 of his deposition, Officer Hughes response was, "I would completely disagree." Officer Hughes was then asked how Ms. Nall had physically interfered with him. His response was, "Her physically moving her body around in that apartment required me to direct my attention at her, to make sure that I was not going to get blindsided, get - whatever. It took my attention away from what I was trying to do with Mr. Nall and, therefore, I was

not able to complete that task." (Hughes depo. pg. 39, lines 7-13)

Even after Officer Collins and Officer Soto were able to remove Mr. Nall from the living room, Ms. Nall continued to be disorderly and to obstruct. Officer Hughes said, "After Officer Soto and Officer Collins were able to take Mr. Nall, I re-entered the living room and I told - I warned her again to calm down, stop yelling or she would be placed under arrest, and she continued to yell." (Hughes depo. pg 40, line 24 - pg. 41, line 3) It was at that point that Officer Hughes removed his handcuffs and told Ms. Nall that she was under arrest. It is my opinion that Considering the totality of the circumstances, Ms. Nall's turbulent actions, obstructed the Painesville Officers during the arrest of Mr. Nall and would have caused any reasonable officer to believe that probable cause existed to arrest Ms. Nall.

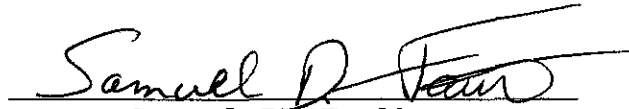
It is my understanding that additional information may be ordered and produced in this case. Therefore I respectfully request that this be considered a preliminary account of my opinions based on the materials that I have reviewed. If any additional information is provided that materially alters any of the above opinions I will either make a written supplement to this paper, or make myself available to respond to the newly produced information during any scheduled deposition.

Exhibits and demonstrative materials:

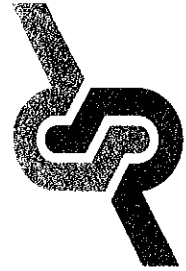
1. Personal resume;
2. Listing of the cases in which I have testified within the last four years;
3. Publications;
4. Action - Response Continuum
5. Probable Cause Triangle;
6. *Taser International Celebrated 77,777 Saves*, E-mail release on Sept. 8, 2011;
7. *DC9 Death Case: Drug Rumor Finally Debunked*, (an example of the type of e-mails that are sent out by Taser International multiple times per week) September 19, 2001;
8. *New Study Ranks Risk of Injury From 5 Major Force Options*, Force Science Research Center, Force Science News #102;
9. *Police Use of Force, Tasers and Other Less-Lethal Weapons*, U.S. Department of Justice, Office of Justice Programs, National Institute of Justice, Research in Brief, May, 2011;
10. *Study of Deaths Following Electro Muscular Disruption*, Key points from below referenced Special Report, with page

numbers for easy reference;

11. *Study of Deaths Following Electro Muscular Disruption*,
U.S. Department of Justice, Office of Justice Programs,
National Institute of Justice, Special Report, May, 2011.

A handwritten signature in black ink, reading "Samuel D. Faulkner". The signature is written in a cursive style with a horizontal line underneath the name.

Samuel D. Faulkner
September 29, 2011



PERSONAL RESUME

Samuel D. Faulkner
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Education:

Ridgewood High School, New Jersey, June 1967
Hiram College, Hiram, OH; Bachelor of Arts in Education, June 1971;
Major: Health, Physical Education and Biology;
Phi Beta Kappa Educational Honor Fraternity;
Taught Martial Arts and Self-Defense for the P.E. Department
Kent State University, Kent, OH;
Masters Degree in Physical Education, Exercise Physiology area of Concentration,
August, 1977;
Instituted and Instructed Martial Arts and Self-Defense Programs;
Led KSU Noon Exercise Program for local businessman and professors, which was part
of a 20-year fitness study initiated by Dr. Larry Golding;
Conducted fitness testing for KSU Athletic Department for cardiovascular fitness,
strength, flexibility, and body composition
Also taught at Hiram College and Ursuline College
Wright State University, Post-masters work and study in the Department of Adult
Education, 1991 -
Northwestern University, Center for Public Safety/Traffic Institute, College of Staff and
Command

Law Enforcement Work Experience

1983 – 1984 - Portage County Adult Probation through a State of Ohio program
involving intensive supervision of adult felons, full time
1984 – 1987 - Deputy Sheriff, commissioned with Portage County Sheriff's Office, part
time working in the detective bureau working on drugs, warrant service and extradition of
prisoners
1984 – 1987 - Robinson Memorial Hospital Police Department uniform police officer,
full time
1987 – 1987 - City of Kent, Ohio Police Officer uniform patrol, full time
1987 – 2000 – Held a commission as a deputy sheriff with Madison County Sheriff's
Office
2000 – 2004 - Port of Columbus Airport Authority Police Department uniform patrol,
part time
2004 – December 2008 - Mechanicsburg Police Department part time uniform patrol on
nearly a weekly basis and hold the rank of Lieutenant. Mechanicsburg is a village of

approximately 1200, 30 miles west of Columbus, Ohio, 20 miles east of Springfield, Ohio and 35 miles east of Dayton, Ohio

1987 – January 30, 2009 - Full time employment with the Ohio Peace Officer Training Academy, a section of the Ohio Attorney General's Office. My job title was a Law Enforcement Training Specialist, in one of the most active training academy in the nation.

December 2008 – Present – Chief Of Police for the Village Of Mechanicsburg Police Department.

Law Enforcement Teaching Experience

State Discipline Chairperson in Defensive Tactics for Basic Peace Officer Training, State of Ohio;

State Discipline Chairperson in Physical Conditioning for Basic Peace Officer Training, State of Ohio;

Ohio Peace Officer Training Academy, Commander for Basic Peace Officer Training;

FitForce Instructor/Trainer

Areas of Instruction

Defensive Tactics Instructor Course;
Baton Instructor Course;
ASP Expandable Instructor Course;
Fitness Specialist Course;
Fitness Assessment and Programming Course;
Response to Resistance Liability Reduction Course;
Peace Officer Survival Training;
Police Officer Tactical Awareness and Response Course;
Defensive Tactics for Female Officers;
Defensive Driving;
Communications Response Tactics;
Developing a Winning Attitude;
Developing a Street Ready Mind and Survival Fitness Training;
Becoming A Leader Your Officers Want To Follow;
Aerosol Agent Instructor Course;
How To Conduct A Female Self-Protection Clinic;
Weapon Retention/Shot Avoidance;
Deadly Force n Force Scenario Training;
Tactical Restraint Instructor Course

Prior Teaching Experience

Ohio Department of Natural Resources;

Bureau of Criminal Identification and Investigation;
Ohio State Capital Guards;
Ohio State Highway patrol;
Lexington, Kentucky SWAT Team and Riot Squad;
Lexington, Kentucky Street Officers;
Miami Valley Joint Force SWAT Team;
Ohio Women in Policing Seminar;
Miami Valley Correction Officers;
City Center Security Guards, Columbus, Ohio;
W.O.R.T.H. Correctional Facility , Lima, Ohio;
Holzer Medical Center;
Guest Lecturer in Use of Force for the Kentucky Office of the Governor Criminal Justice Training;
Train the Trainers Course for the State of West Virginia in Defensive Tactics;
Train the Trainers Course for the Commonwealth of Kentucky;
Consultant to State of Ohio Department of Rehabilitation and Corrections on Response to Resistance;
Ohio Military Reserve
Montana Attorney General's Office;
Montana State Police;
West Virginia State Police;
Michigan State Police;
Virginia State Police;
International Association of Law Enforcement Firearms Instructors;
The majority of law enforcement agencies throughout the State of Ohio
Adjunct Professor – Clark State University;
Instructor at:
Muskingum Technical School;
Montgomery County Joint Vocational School;
Akron University;
Kent State University;
Sinclair Community College;
University of Rio Grande;
University of Illinois at Chicago

Educational Work Related Experience

320 Hour Academy Police Basic Training;
Certified Police Academy Instructor, State of Ohio;
Active Countermeasures Instructor;
Pressure Point Control Tactics Instructor;
Baton Instructor;
Defensive Tactics Instructor/Trainer
Instructor/Trainer in Defensive Tactics for PPCT Management Systems;
Physical Crisis Intervention;
Officer Tactics and Advanced Field Tactics;

PR-24 and Kubaton Instructor;
State Certified Semi-Automatic Firearms Instructor;
RIPP Restraint Instructor;
CAP-STUN Aerosol Spray Instructor;
Hand Held Aerosol Agent Instructor/Trainer;
ASP Expandable Baton Instructor;
ASP Expandable Baton Instructor/Trainer
Board of Examiners for ASP Baton and ASP Tactical Restraint
Close Quarter Personal Control Instructor;
Vehicle S.T.O.P.S. Instructor;
Defensive Driving Instructor;
Principle Based Response Tactics Instructor
Principle Based Response Tactics Instructor/Trainer;
Master Ground Defense Instructor
Conductive Energy Device Instructor
Chairman of the Board of Examiners for ASP Baton and ASP Tactical Restraint

Court recognized expert witness in Use of Force, Response to Resistance, Defensive Tactics, Subject Control and Police Procedures in both criminal and civil cases.

Author of Action – Response Model adopted by Advanced Police Training, Basic Peace Officer Training, Corrections Training, Private Security Training and Bailiff's Training for the State of Ohio.

Expert advisor and witness for the Ohio Peace Officer Training Commission and the State of Ohio Attorney General.

Member of the Governor's Office of Criminal Justice Services Law Enforcement Use of Force Liaison Committee.

Presenter/Discussant for the 1992, 1993, and 1997 Annual Meeting of the Academy of Criminal Justice Sciences.

Instructor in Forum For Comparative Program, Topic: Use of Force in the Correctional Environment;

Instructor at the 1992, 1993, 1996, 1997, 1998 and 2000 Attorney General's Conference on Law Enforcement, Topics: Use of Force and Leadership;

Instructor at the 1994, and 1999 American Society of Law Enforcement Trainers Annual Conference, Topic: Use of Force and Action-Response Continuum;

Instructor at Regional and National AFSCME Corrections United Seminars, Topic: Use of Force in a Correctional Environment;

Research Project in 1997 with the U.S. Justice Department, national Institute of Justice defining reasonable responses for law enforcement;

Research Project in 1998 with Ohio Department of Youth Service developing a Use of Force Model for control of juvenile violence;

Consultant to U.S. Justice Department, National Institute of Justice on Use of Force issues;

Consultant to Calibre Press, Street Survival Seminars on Use of Force, and Control Tactics;

Presented Action-Response Model to the National Major Gang Taskforce;

Consultant to hundreds of Police Departments and Sheriff's Offices on Response to Resistance Policies or Action-Response Policies;

Presented the Action-Response Continuum Model to the 2001 National Association of Attorney Generals (NAAG) Conference in San Diego, CA;

Presented the Action-Response Continuum Model to the 2005 National Association of Attorney Generals (NAAG) Conference in 'Washington, DC

Presenter and Discussant at Ohio Chief's Of Police, Electro-Muscular Disruption Technology Symposium in Columbus, Ohio, November 2-3, 2005
Consultant for the U.S. Department Of Homeland Security

Developed the vendor neutral individual chemical repellent instructor training for the State of Ohio Attorney General's Office

Developed the vendor neutral conductive energy device instructor training for the State of Ohio

Champaign/Logan County Crisis Intervention Team Training – Nov. 1-4, 2010,
Instruction in the "Memphis Model" that has been adopted in 35 states

Requested to instruct in subsequent Champaign/Logan County Crisis Intervention Team Trainings

Instructor in Budapest, Hungary, August 2007 - Trained officers from over twenty different countries

Instructor in Madrid, Spain, August, 2009 – Trained officers from over twenty different countries

Instructor in Hong Kong, October 2010 - Trained officers from over twenty different countries

July 15, 2011, Presenter in Governmental Liability Seminar for OACTA, the Ohio Association of Civil Trial Attorneys

Publications in:

Ohio Police magazine;
The Defensive Tactics News Letter;
Working the Streets, Mid-West D.T. News Letter;
The State of Ohio Basic Training Curriculum for Basic Peace Officer Training, Basic Correctional Officer Training, Basic Private Security Training and Basic Bailiff's Training;
The Action-Response Continuum;
Law and Order Magazine;
National Sheriff's Magazine;
Tactical Edge Magazine;
Police Science;
POLICE Magazine;
The Buckeye Badge;
Training aids Digest;
Close Quarter Personal Control Basic and Instructor manual;
Strategies & Tactics of Patrol Stops (S.T.O.P.S.O Basic and Instructor manual;
FBI Law Enforcement Bulletin;
FBI Journal;
American Journal of Criminal Justice;
Numerous programs on the Law Enforcement Television Network (LETN);
Author of a book published by the Ohio Attorney General's Office,
USE OF FORCE, DECISION MAKING AND LEGAL PRECEDENCE;
2001 Ohio Chief's of Police Magazine on writing Response to Resistance Policies;
Commission for Accreditation of Law Enforcement Agencies (CALEA) National Journal. October, 2004

Honors and Other Activities

Speaker at Ohio Chiefs of Police Fitness Seminar, 1989;
Helped establish and perform initial fitness assessment for Richland County ASORT Team;
Speaker at seminar for Safety and Security Officers in health care organizations;
Elected by Buckeye State Sheriff's Association to establish a defensive tactics curriculum for statewide mandated correctional officers training program, and to teach the train the trainers course in same;
Medalist in the 1985 Ohio Law Enforcement Olympics in Martial Arts;
Double Gold Medalist in the 1986 Ohio Law Enforcement Olympics;
Participant in the 1986 International Law Enforcement Olympics;
Honorary Kentucky Coronal;
1997 Ohio Attorney General's Office Attorney General's Professional Award
Member of Ohio Association of Chiefs of Police, OACP
2009 Ohio Distinguished Law Enforcement Training Award

Military Background

USMC Basic Training at Paris Island

PFC Meritoriously;

Platoon Dress Blue Honor Man

National Spirit Honor Medal from Congress awarded to 1 in 10,000 Marines;

First person in the history of Marine Corp Boot Camp to graduate with perfect

Proficiency and Conduct evaluation marks;

USMCR Instructor in hand-to-hand combat and physical training;

Honorably discharged with the rank of sergeant.

CASES IN WHICH SAMUEL D. FAULKNER HAS TESTIFIED AT TRIAL
OR IN DEPOSITION THE PAST FOUR YEARS

1. Jonathan E. Hall v. The City of Huntington, et al, Case No. 3:06-cv-00070,
U.S. District Court, Southern District, West Virginia
Deposition - February, 2007
2. Loretta Norman v. City of Lorain, Ohio, et al., Case No. 1:04 CV 0913,
U.S. District Court, Northern District Of Ohio, Eastern Division,
Deposition – March, 2007
3. Tracey Baker v. Jeffrey Sandlin, Case No. 1:05 CV 632,
U.S. District Court, Southern District Of Ohio, Western Division,
Deposition – March, 2007
4. Paul Sammons v. Deputy Chad P. Barker, et al., Case No. 2:07-0132,
U S District Court, Southern District of West Virginia, At Charleston,
Deposition - January, 2008
5. Alfred J. Edwards and Mary Eva Edwards v. City of Martins Ferry, et al.,
Case No. 2:06 CC 789, U S District Court, Southern District of Ohio, Eastern Division,
Deposition - January, 2008
6. William R. Reed v. Nashville Metropolitan Police Department, Civil Service Hearing,
Deposition – May, 2008
7. Lyndal Kimble v. Officer Greg Hosos et al., Case No.: 4:03 CV 2379,
United States District Court, Northern District of Ohio, Eastern Division,
Deposition – July, 2008
8. David Anderson v. Tim Haynes & City of Sistersville, Case No. 1:07-CV-2,
U.S. District Court of West Virginia, Wheeling Division,
Deposition – September, 2008, Steptoe & Johnson, Monte Williams
9. Commonwealth of Kentucky v. James Kyne, Case No. 06-CR-505,
Court of Common Pleas, Covington, KY
Trial - October - 2008, Prosecutor, Covington, KY
10. Marion Maynard, Jr. v. Deputy Norman Mines, and the Mingo County Sheriff's Department,
Case No. 7:07-CV-131, U.S. District Court, Eastern District of Kentucky, Southern
Division, At Pikeville,
Trial – November, 2008, Pullin, Fowler, Flanagan, Brown and Poe,

Julie M. Meeks and Stephen M. Fowler

11. Commonwealth Of Kentucky v. Terry Williams, Jr., Case No. 07-CR-538,
Commonwealth Of Kentucky, Kenton Circuit Court, 3rd Division
Trial – 2009, Prosecutor, Covington, KY
12. John Slater v. Adam Scott, et al., Case No: 06-C-1661,
Circuit Court Of Kanawha County, West Virginia,
Deposition – January, 2009, Pullin, Fowler, Flanagan, Brown & Poe, Gary Pullin
13. Richard Revely et al. v. City of Huntington, et al., Case No.: 3:07-CV-00648,
U.S. District Court, Southern District of West Virginia, at Huntington,
Deposition – February, 2009, Offut Nord, PLLC, Ryan Ashworth
14. Matthew Davis v. City Of Ashtabula, et al., Case No. 1:08-cv-00776,
US District Court, Northern District Of Ohio, Eastern Division,
Deposition – November, 2009, Mazanec, Raskins, Ryder & Keller, Todd Raskins
15. Lois Porter, et al. v. City of Ironton, et al., Case No. 1:08 CV 368,
U.S. District Court, Southern District of Ohio, Western Division,
Deposition – May, 2010, Freund, Freeze & Arnold, Ken Harris
16. Mark D. McCullaugh, et al. v. Office of County Executive Summit County, et al.,
Case No. 5:07-CV-2341, U.S. District Court, Northern District of Ohio, Eastern Division,
Deposition - July 2009 - Cleary & Associates, Tom Amato
17. Jeffrey Mconnell et al. v. Jeffrey Griffith, et al., Civil Action No. 5:08-CV-133,
U.S. District Court, Northern District of West Virginia,
Trial - February, 2010, MacCorkel, Lavender & Sweeny, Heather Noel
18. Tonya M. Martin v. City of Broadview Heights, Case No. 1:08-cv-2165,
U.S. District Court, Northern District of Ohio, Eastern Division,
Deposition - July, 2010, Mazaned, Raskins, Ryder & Keller, Todd Raskins & Carl Cormany
19. Gary Clyde Borham, and Linda Ann Borham v. Eric Popish, et al., Civil Action
No. 5:09-CV-65, United States District Court, Northern District of West Virginia,
Deposition - July, 2010, Bailey & Wyant,
20. Jeff Becker v. City Of Westover, et al., Civil Action No. 08-C-877,
Circuit Court Of Monongalia County, WV
Trial – August 2010, MacCorkle, Lavender & Sweeney, Heather Noel
21. Robert Burns v. West Virginia Regional Jail and Correctional Facility Authority, et al.,
Case No. 2:09-CV-01199, U.S. District Court, Southern District of West Virginia,
Charleston Division, Pullin, Fowler, Flanagan, Brown & Poe, Julie Meeks

22. U.S. v. John Gray, et al., Case No. 3:09 CR 182,
U.S. District Court, Northern District Of Ohio, Western Division
Trial – November 20, 2010, Judge Katz, Attorney Neil Mc Elroy, Jell Helmick and Spiros P. Cocoves
23. Donald Webb III, v. Adam Henderson, et al., Cause Action 24C01-0704-CT-153,
Franklin Circuit Court. State Of Indiana
Trial – March 16, 2011, Special Judge, Attorney Jay D. Patton & Wayne E. Uhl, Esq.
24. Rayshaid M. Robinson v. The Health Alliance of Greater Cincinnati, et al.,
Case No. 1:09CV164, United States District Court, Southern District of Ohio, Western
Division, Cincinnati
Trial – May 26, 2011, Graydon Head & Ritchey, LLP, Attorney Katherine Lasher
25. Webb, Mary/Robert v Raleigh Sheriff's Office, et al. Civil Action No. 08-C-406-H,
Circuit Court Of Raleigh County, West Virginia
Trial – July 18, 2011, Pullin, Fowler, Flanagan, Brown & Poe, Attorney Chip E. Williams

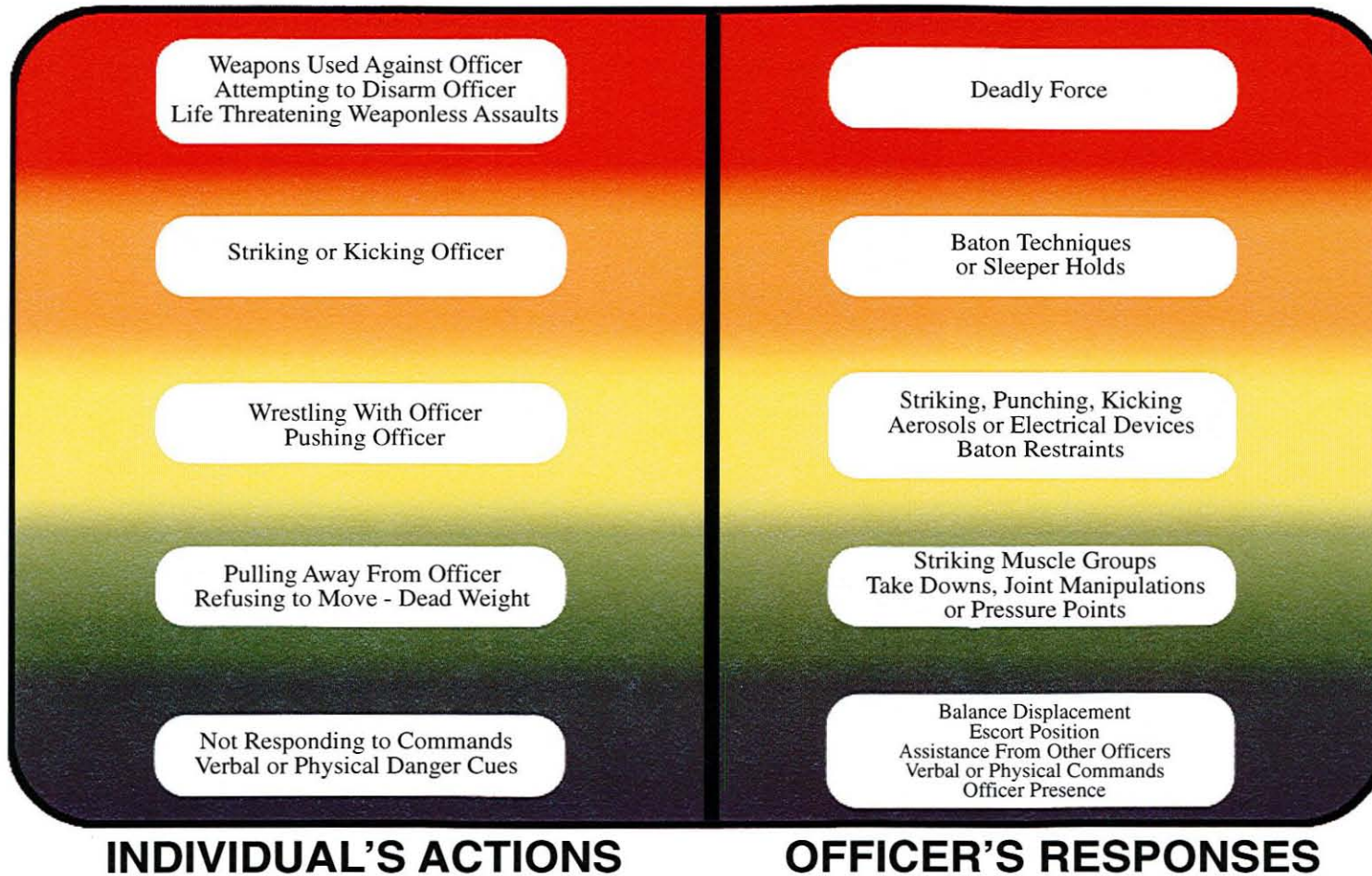
PUBLICATIONS

1. *Individual and Situational Determinants of Police Force: An Examination of Threat Presentation*, American Journal of Criminal Justice, Vol. 23 No. 1, 1998;
2. *Policing Is Not A Football Game*, Law and Order, Vol. 42, No. 5, May, 1994;
3. *A Ralph Nader Approach To Law Enforcement Training, Subject Control – Unsafe At Any Speed*, Police Studies, The International Review of Police Development, In affiliation with the Police Section of the Academy of Criminal Justice Sciences, Vol. 17, Number 3, Fall, 1994;
4. *Defining Reasonable Use Of Force*, Training Aids Digest, Vol. 19, No. 2, February, 1994;
5. *Officer – Action, Use Of Force Continuum*, Defensive Tactics Newsletter, Volume 1, Number 1, July, 1991;
6. *Subject Control In The Real World*, Working The Street, Volume 1, Issue 1, Jan/Feb/March, 1994;
7. *Defining Reasonable Force*, Line of Duty, Vol. 4, Issue 3, Fall, 1998;
8. *Understanding The Action – Response Use Of Force Continuum*, Close Quarter Personal Control Student & Instructor Manuals, 1991;
9. *Words, The Ammunition of the Courtroom*, CALEA Update, October, 2004;
10. *Policing Is Not A Football Game*, Law and Order, Vol. 42, No. 5, May, 1994;
11. *Use of Force: response to another's action of resistance*, Ohio Police Chief Magazine, Winter, 2001;
12. *Police Use Of Force*, The ASLET Journal, July/August, 1994, Volume 9, Issue 4;
13. *Use Of Force Questionnaire*, POLICE, The Law Officer's magazine, Volume 17, Number 1, 1993;
14. *The Faulkner Frisk*, POLICE, The Law Officer's Magazine, Volume 16, Number 2, 1992;
15. *Let's Twist Again*, POLICE, The Law Officer's Magazine, Volume 16, Number 4, April, 1992;
16. *Grip, Dip and Twist*, The Tactical Edge, Winter, 1993;

17. *The Faulkner Frisk*, The Tactical Edge, Fall, 1992;
18. *An Open Letter to Society*, The Tactical Edge, Spring, 1994
19. *Faulkner On Force Part I and Part II*, Calibre Press Street Survival magazine No. 73, 06/19/96;
20. *LETN Films Use Of Force Continuum at OPOTA*, The Buckeye Badge, Volume #4, Issue 2, Spring, 1994;
21. *Firearms training any time, anywhere*, Law Enforcement Technology, August, 1999;
22. *Use Of Force Survey Response*, POLICE, The Law Officer's Magazine, Volume 17, Number 7, 1993;
23. *USE OF FORCE, Decision Making And Legal Precedence*, Ohio Attorney General's Office

ACTION - RESPONSE CONTINUUM

IMPORTANT - The list of officer responses is *not* intended to be in any specific order, but reflects on the amount of resistance encountered. The officer will choose the necessary response to gain control of the situation based on departmental policy, his physical capabilities, perception, training and experience.



OFFICER - SUBJECT FACTORS

1. Age
2. Sex
3. Size
4. Skill Level
5. Multiple Subjects/Officers
6. Relative Strength

SPECIAL CIRCUMSTANCES

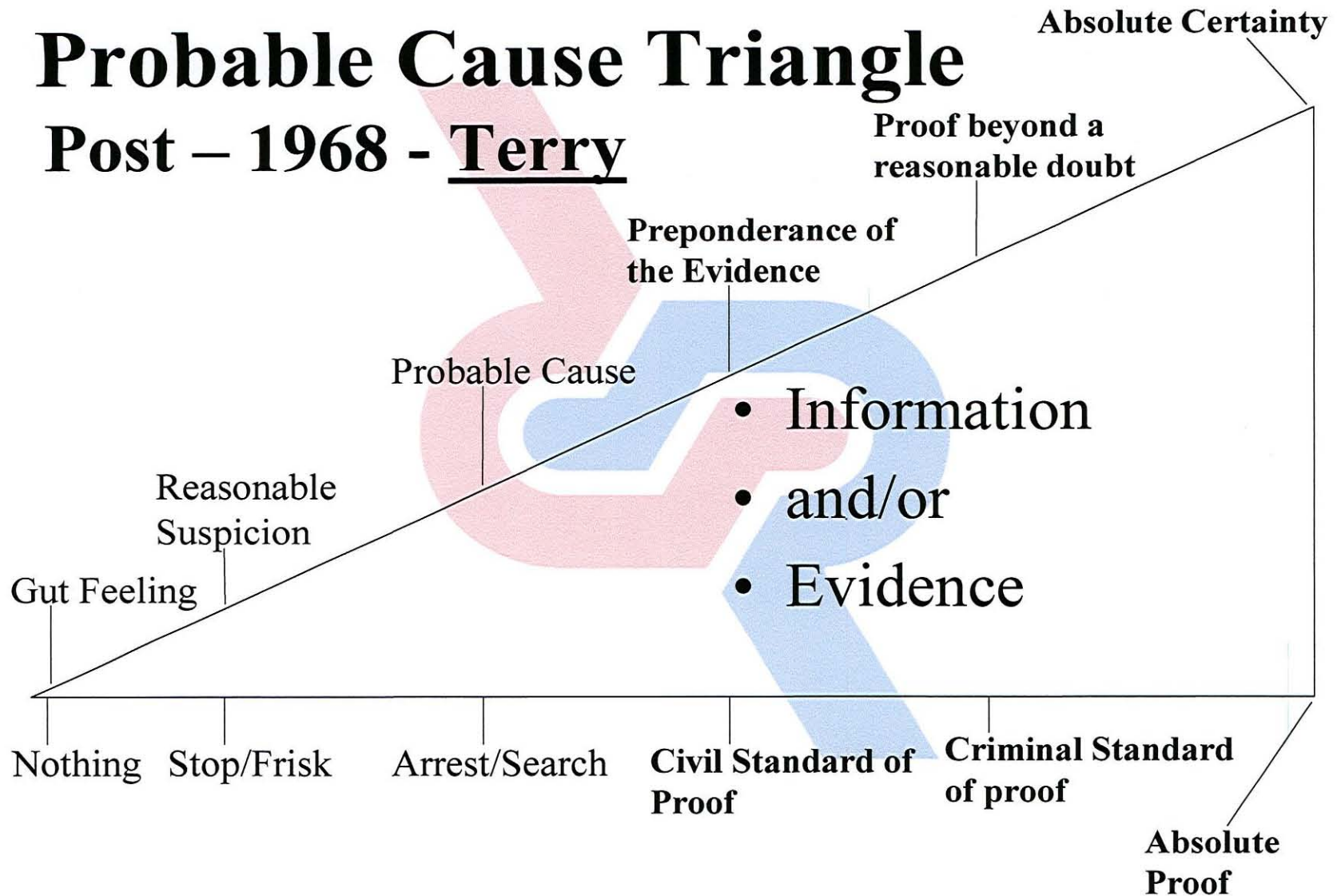
1. Closeness of a Weapon
2. Injury or Exhaustion
3. Being on the Ground
4. Distance From the Subject
5. Special Knowledge
6. Availability of Other Options
7. Environmental Conditions
8. Subject Handcuffed

Continuum of Arrest:

Control – Handcuff – Search – Evaluate – Transport

Probable Cause Triangle

Post – 1968 - Terry



FOR RELEASE ON: Sept 8, 2011 at 7:30 a.m. ET

CONTACT: Stephen Tuttle
Vice President, Communications
TASER International, Inc.
Media Hotline: (480) 444-4000

TASER International Celebrates 77,777 Saves

“Saves Counter” is launched estimating the lives saved from potential death or serious injury with TASER ECDs on TASER.com

SCOTTSDALE, Ariz., Sept 8, 2011 — TASER International, Inc. (NASDAQ: TASR) today launched a new “Saves Counter” that tracks estimates of the number of people whose lives have been saved from potential death or serious injury using TASER® devices. The Saves Counter is posted on the home page of TASER.com.

The Saves Counter was developed based on a statistical analysis of TASER usage patterns in the more than 16,300 agencies using TASER ECDs today. Some key statistics:

- More than 600,000 TASER ECDs are used by law enforcement officers worldwide
- 107 countries deploy TASER ECDs
- ECDs are deployed roughly once every two years in the field based on reported usage patterns
- TASER ECDs have been used in approximately 1.4 million incidents
- The usage equates to roughly 2.3 times for each TASER ECD fielded since 1999
- An analysis of field uses of ECDs published in the *[Journal of Trauma](#)* found that 5.4% of TASER ECD uses were deemed to have clearly prevented use of lethal force by police
- 5.4% of the 1.4 million field incidents of TASER deployments equates to the number of people saved from serious risk of injury or death
- TASER ECDs are deployed more than 900 times each day worldwide

“The Saves Counter is an important reminder to our employees and the brave men and women of law enforcement about the valuable work they do every day,” said Tom Smith, Chairman and Founder of TASER International. “The Saves Counter is linked not just to the math behind the estimate, but to videos and reports of the heroic efforts of law enforcement officers to save lives with ECDs. It is with sincere gratitude that we thank these brave men and women for the risks that take every day to keep our communities safe.”

About TASER International, Inc.

TASER International, Inc. (NASDAQ:TASR) is a global provider of safety technologies that prevent conflict and protect life. More than 16,300 public safety agencies in 107 countries rely on TASER® electronic control devices (ECDs) and AXON on-officer camera systems to help protect and serve. Today, the use of a TASER ECDs have saved more than 77,777 lives from potential death or serious injury while TASER innovations benefit individuals and families too,

providing personal protection and accountability while maintaining regard for life. Since 1994, more than 236,000 individuals have relied on TASER technology as a means for effective personal safety. Learn more about TASER International and its solutions at www.TASER.com and www.Evidence.com or by calling (800) 978-2737. Be a part of the TASER community by joining us on [Facebook](#), [LinkedIn](#), [Twitter](#), and [YouTube](#).

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DC9 Death Case: Drug Rumor Finally Debunked

Posted by [Rend Smith](#) on Sep. 19, 2011 at 4:58 pm

<http://www.washingtoncitypaper.com/blogs/citydesk/2011/09/19/dc9-death-case-drug-rumor-finally-debunked/>



Almost a year later, [there are still lingering questions](#) about the death of Ali Ahmed Mohammed outside the DC9 nightclub.

One of the most prominent among them: That the young Ethiopian was in a drug-fueled rage on the October night when he allegedly chucked a brick at the club's window and subsequently ended up dead.

[Writing the story of Mohammed's death](#), I was told privately by some of the club's supporters that Mohammed had died of personal recklessness. He was a known addict, they said. He'd gotten high and flown off the handle before, folks claimed, once wrecking a perfectly good Adams Morgan diner. "Find that diner," I was advised. But the diner never materialized. And now, according to autopsy documents recently obtained by City Desk, the 27-year-old had no illicit chemicals kicking around his system at the time of his death.

After the explosion of glass, Mohammed was allegedly chased down by five DC9 employees. Moments later, he was dead. Cops immediately accused the group of kicking Mohammed to death, touching off a firestorm of protest in D.C.'s Ethiopian communities. "We want justice," was the most common chant.

But later, the five men [were cleared of any criminal wrongdoing](#). Authorities now believe that upon catching up with Mohammed, the men merely restrained him. In an announcement, the D.C. medical examiner explained that Mohammed's death was caused by "excited delirium associated with arrhythmogenic cardiac anomalies, alcohol intoxication and physical exertion with restraint." In other words, while he was being held onto, his heart gave out. Though drugs weren't mentioned as a cause, "excited delirium" [is often associated with drug use](#). Unlike some other jurisdictions, D.C. doesn't make its autopsy documents public, so it was impossible to peruse Mohammed's toxicology report up until now.

At the time of his death, Mohammed tested negative for amphetamines and barbiturates and cannabinoids and cocaine metabolites and methadone and most others drugs you could name. Dr. Moses Schanfield, a professor of Forensic Science and Anthropology at George Washington University, emails that "different drugs have different metabolic life times" but that for the most part the negative results mean Mohammed hadn't consumed any drugs in 24-48 hours.

Still, that's not to say he was completely in control. The "intoxication" the medical examiner mentioned might have been intense. Mohammed's blood alcohol content was 0.22, that's significantly over the 0.08 alcohol level D.C. law says impairs drivers. But Schanfield contends it's difficult to say just how drunk Mohammed was: "How impaired was he? Though there is a good correlation between BAC and impairment, it is modulated by how habituated to alcohol the victim was. If he was an alcoholic he might of been only mildly impaired, if a light drinker he would have been impaired significantly more."

As someone who reports on crime, I've learned a great deal about racial and cultural rifts from Mohammed's case. And I've also learned a thing or two about how we deal with tragedy. Pretty much everyone involved in the case —cops, prosecutors, community advocates, defense attorneys, rockers, reporters—have all, at some point, been dead wrong. And so have the rumor-mongers talking about Mohammed's drug use

Family of homicide victim speak out

Conn. man died hours after being in police custody

Updated: Tuesday, 20 Sep 2011

http://www.wpri.com/dpp/news/local_news/south_county/westerly-ryan-oloughlin-death-ruled-homicide-died-after-police-custody

Nancy Krause

WESTERLY, R.I. (WPRI) - Months after a Connecticut man died shortly after being in the custody of Westerly police, the Connecticut Medical Examiner's Office ruled the death a homicide.

Ryan O'Loughlin, 34, was arrested in June outside the Perks and Corks wine and coffee bar in Westerly on charges of disorderly conduct and resisting arrest. Before police put O'Loughlin in custody, the family's attorney said they pepper sprayed him.

O'Loughlin was dead 16 hours later.

"I will never understand how anybody could treat a human being like that," O'Loughlin's wife said in court Tuesday.

In a report released Tuesday morning, the medical examiner said the manner of death was "homicide as the result of blunt abdominal trauma."

Shortly after O'Loughlin's death, then-Westerly Police Chief Edward Mello told Eyewitness News he has no evidence to believe Westerly officers caused the death of the suspect, and wondered if O'Loughlin had a pre-existing medical condition.

The victim's family disputes that claim, saying O'Loughlin - who had served in the Gulf War - was healthy and had never been in trouble before.

O'Loughlin's wife said, "I will do everything I can to make sure that the people who killed him will be responsible for their actions."

"No crime was made by him and no violence and he's dead," O'Loughlin's mother said.

Autopsy: Teen's death in custody was cocaine-related

By Patrick George | Monday, September 19, 2011, 10:55 AM

http://www.statesman.com/blogs/content/shared-gen/blogs/austin/blotter/entries/2011/09/19/autopsy_teens_death_in_custody.html

A teenager's death while in police custody this summer has been ruled cocaine-related by the Travis County medical examiner, according to an autopsy report.

Surleslie Hall, 17, was arrested July 18 on charges of impersonating a police officer. Police officials said that while being booked into the Travis County Jail, Hall had a "medical crisis." He was taken by ambulance to a hospital, where he was later pronounced dead.

The autopsy report, completed late last month, said Hall died of acute cocaine toxicity. Hall had a history of drug use and depression, the autopsy report said.

Police have said that Hall was at a fast-food restaurant that morning in the 9500 block of North Lamar Boulevard when he called 911.

Wearing a shirt that said "Police" on it, Hall alternately told dispatchers he was a police officer and a security guard and said his handcuffs had been stolen, officials said. Witnesses at the restaurant told police that Hall had identified himself to them as an officer, officials said.

Officers took Hall into custody, with police saying it was an "unremarkable arrest" with no force used and that Hall did not struggle.

Hall's family could not be reached for comment. In July they said Hall had some run-ins with the law, but wanted to be a police officer. They said they weren't aware of him using any drugs or having medical problems.

Fort St. John in-custody death under investigation

By: Sean Assor

Monday, September 12, 2011

<http://www.energeticcity.ca/fortstjohn/news/09/12/11/fort-st-john-custody-death-under-investigation>

New Westminster RCMP are currently investigating the in-custody death of a 46-year-old male in Fort St. John this weekend.

On Saturday, RCMP confirmed that the male died Friday evening in the Fort St. John Detachment. The male was arrested after the RCMP responded to a call just after 5 p.m. Friday September 9.

Investigators are currently conducting interviews with anyone who they think can help in the investigation. The coroner's office is also conducting its own investigation of the death. Police are waiting to notify the next of kin of the deceased before releasing more information. The RCMP says it's too early to speculate the cause of death and will release more information as their investigation continues.

Man dies while in Lower Township police custody

Written by Staff Reports

Tuesday, 30 August 2011 10:24

<http://www.shorenwstoday.com/snt/news/index.php/cape-may/cape-may-events/15749-man-dies-while-in-lower-township-police-custody.html>

LOWER TOWNSHIP – Cape May County Prosecutor Robert L. Taylor and Lower Township Police Chief Brian Marker said Monday that their offices are investigating the death of James O'Neill, 40, of North Cape May, after he died while in police custody.

At approximately 3:30 a.m., the Lower Township Police Department received a 911 call from a resident of Wayne Avenue who reported O'Neill was in the process of breaking into a residence on the 600 block of Wayne Avenue.

Police officers responded and observed O'Neill with lacerations of the arms, a broken window and blood at the front of the property, according to police.

O'Neill has had previous police contacts for mental health related issues. He was a resident of the 600 block of Wayne Avenue in North Cape May where he was alleged to be breaking into a home. Police apprehended O'Neill, who physically resisted the initial responding officer's commands and attempts to restrain him, according to police. During the struggle, a private citizen assisted police in controlling O'Neill and he was eventually handcuffed.

As rescue personnel were evaluating him, O'Neill lost consciousness and stopped breathing. Attempts were made to revive him by Lower Township Rescue while en route to the hospital. O'Neill was pronounced dead at Cape Regional Medical Center.

Subsequent investigation revealed that numerous prescription medications were found in O'Neill's residence, according to police. An autopsy was conducted by the Southern Regional Medical Examiner's Office who determined that the cause and manner of death are pending toxicological testing.

O'Neill had numerous previous police contacts both in New Jersey and Delaware and had been arrested for aggravated assault on a police officer, resisting arrest and terroristic threats, according to police.

As per the New Jersey Office of the Attorney General, the Division of Criminal Justice was notified of an In Custody Death and the ongoing investigation is under the authority of the Cape May County Prosecutor's Office.

Tests will determine suspect's cause of death

Aug 21, 2011 | <http://www.hometownlife.com/article/20110821/NEWS24/108210511>

By LeAnne Rogers

Observer Staff Writer

Results of a toxicology report are being awaited in the death of a man who had forced his way into a Westland home and assaulted an elderly resident.

Donald Murray, described as in his 30s, collapsed July 30 while being taken to a patrol car. Officers began CPR on Murray, who was transported by Fire Rescue to an area hospital where he later died, said Westland Police Lt. Michael Matich.

The incident began about 2 p.m. when Murray knocked on the door of a home on Beechnut, then forced his way into the home when an 80-year-old woman answered the door, Matich said.

"He was forcing her to the back of the house into a family room area. Her adult son was in the basement and heard something — he thought his mother had fallen," said Matich. "He went to check and was confronted with the intruder."

The son, 47, tried to get the intruder out of the house but the suspect had armed himself with a decorative item that he was going to throw at the elderly woman, Matich said.

"They (the two men) struggled and ended up back out the front door. The suspect fell off the porch and hit his head on a landscaping brick," said Matich. "The scuffle continued as the son tried to keep the suspect there while police were called."

A neighbor who was taking a walk stopped and help detain the suspect until officers arrived. Murray continued to be combative, Matich said, fighting with officers who eventually were able to restrain him.

"The officers walked him to the patrol car. Before they put him into the car, he had a medical emergency," said Matich. "The officers had already called rescue and did CPR. He died at the hospital."

The elderly woman received minor injuries and was also transported to the hospital.

During the investigation, Matich said it was learned that Murray had been visiting at a nearby home and abruptly left, then began walking around the neighborhood.

"Through our investigation, we talked to a lot of people. We that learned that just prior to the home invasion he was using narcotics and became very paranoid," said Matich. "They (the people Murray had visited) were not sure what (drugs) he was doing — he'd gone into the restroom. We believe that is where he consumed the drugs."

It was unclear why Murray forced his way into the home on Beechnut.

"He probably didn't know what he was doing — it was excited delirium," said Matich.

Prior to forcing his way into the home, Murray's behavior was erratic enough that another resident who saw him was in the process of calling police. That resident delayed calling 9-1-1 when he went to see what was happening after he saw Murray go into his back yard, Matich said. Murray then continued to the woman's home.

Following an autopsy, the Wayne County Medical Examiner lists Murray's cause of death as pending until receipt of the toxicology report which takes several months.

Inquest ordered into in-custody death

by Wayne Moore - Story: 63724

Aug 10, 2011 / 3:00 pm

<http://www.castanet.net/news/Kelowna/63724/Inquest-ordered-into-in-custody-death>

The BC Coroners Service will hold an inquest into the death of [Brandt Zimmer](#).

Zimmer, who was 40 at the time, died in Kelowna General Hospital August 15, 2010, while in RCMP custody.

He had been arrested that day after causing a disturbance at Malibu Grand Prix on Stremel Road.

At the time of the incident, Sgt. Ann Morrison said Zimmer was arrested for mischief and noted he was showing signs of medical distress, foaming at the mouth and complaining of shortness of breath. "He was transported to Kelowna General Hospital by ambulance, where he died about an hour later," says Morrison.

Central Saanich Police Service conducted an independent, external investigation into Zimmer's death.

Presiding coroner Mark Coleman and a jury will hear evidence from subpoenaed witnesses to determine the facts surrounding this death.

The jury will have the opportunity to make recommendations aimed at preventing deaths under similar circumstances in the future.

The venue and date for the inquest have not yet been determined.

From: "Force Science Research Center"
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July 18, 2008

www.ForceScienceNews.com

Force Science News #102

In this issue:

New study ranks risks of injury from 5 major force options

How would you rank the relative risk for officers and suspects suffering injury from these 5 force options:

- Empty-hand control techniques
- Baton
- OC spray
- Conducted energy weapons (Tasers)
- Lateral vascular neck restraint.

If you judged OC to be the ?safest? and baton to be ?most injurious? to both officers and offenders, you?re in agreement with the findings of a new study of force encounters involving officers on a major municipal department.

The study, the first of its kind in Canada, was conducted by S/Sgt. Chris Butler of the Calgary (Alberta) Police Service and Dr. Christine Hall of the Canadian Police Research Center.

They analyzed 562 use-of-force events that occurred across a recent 2-year period as officers effected the arrests of resistant subjects in Calgary, a city of more than 1 million population. The threatened or actual use of firearms were omitted from the review, as were handcuffing, low-level pain compliance techniques like joint locks and pressure points, K-9s, and tactical responses such as chemical agents, flashbangs and less-lethal projectiles.

Here?s what they discovered:

- **OC, used in roughly 5% of force-involved arrests, produced the lowest rate of injury.** More than 80% of sprayed subjects sustained no injury whatever. About 15% had only minor injuries (?visible injuries of a trifling nature which did

not require medical treatment?) and some 4% had what the researchers termed ?minor outpatient? injuries (some medical treatment required but not hospitalization). No cases resulted in hospitalization or were fatal.

Officers involved in OC use fared even better. They suffered no injury in nearly 89% of cases and only minor damage the rest of the time.

The pepper spray involved was Sabre Red, with 10% oleoresin capsicum.

- **Batons, deployed in 5.5% of force-involved arrests, caused the greatest rate of higher-level injury.** Fewer than 39% of subjects receiving baton contact remained uninjured. More than 3% were hospitalized and nearly 26% required outpatient treatment, combining to be ?most injurious,? according to the researchers. About 32% of batoned subjects sustained minor injuries requiring no treatment.

Of officers involved in baton incidents, nearly 13% required outpatient treatment. Some 16% sustained minor injury and the rest were uninjured.

In Calgary, the baton used is the Monadnock Autolock expandable with power safety tip.

- **Empty-hand controls, applied in 38.5% of the force events, also ranked high for more serious injuries.** For purposes of the study, physical controls included ?nerve motor point striking and stunning techniques, grounding techniques such as arm-bar takedowns, and other balance displacement methods.?

Nearly 14% of these subjects required outpatient medical care and about 4% had to be hospitalized. Almost 50% had minor injuries and about 33% remained uninjured.

Among officers, 1% required hospitalization and 4.5% needed outpatient aid. The vast majority (77.8%) were uninjured and nearly 17% had minor injuries.

Judging from these findings, the researchers conclude, agencies need ?to seek out alternatives to hands-on physical control tactics and the baton if they wish to reduce the frequency and seriousness of citizen and police officer injuries.?

- **The second safest force mode for suspects proved to be the lateral vascular neck restraint.** Used in 3% of force-related arrests, the LVNR left more than half (52.9%) of offenders uninjured. About 41% sustained minor injuries and less than 6% required minor outpatient treatment. There were no hospitalizations and no fatalities.

Officers applying a LVNR remained uninjured more than 76% of the time and those who were hurt suffered only minor injuries.

- **Conducted energy weapons also scored high in safety for both suspects and officers.** The Taser X26, the CEW issued to Calgary officers, was the most

frequently deployed of the 5 force options studied, being used against nearly half (48.2%) of resistant arrestees. About 1% ended up hospitalized, about 12% needed minor outpatient treatment and more than 42% had only minor injuries. Nearly 45% sustained no injuries and there were 0 fatalities.

Of officers using Tasers, about 83% were uninjured and about 13% sustained minor injuries. Only about 2% and 1% required outpatient medical attention or hospitalization respectively.

The commonly held belief that CEWs carry a significant risk of injury or death is not supported by the data. Indeed, they are less injurious than either the baton or empty-hand physical control, which often would be alternative options where electronic weapons were not available.

In a 14-page report of their study, Butler and Hall point out that no use of force technique available to police officers can be considered safe in the dictionary sense that it is free from harm or secure from threat of danger. Every use of force encounter between the police and a citizen carries with it the possibility for injury for one or all of the participants, however unexpected that injury might be.

The best that can be hoped for is an appropriate, proportional balance between the degree of risk of harm and the resistance faced by police that requires the use of force.

The public has been fed a large amount of incomplete or incorrect information and even intentional artifice about some force options, the researchers charge. Their study, they say, may help eliminate the resulting confusion. Plus, knowing the level of injury likely to result from a given force method can aid trainers and administrators in developing sound policies and practices.

This study is a great snapshot about force and its associated injuries and is a valuable addition to the discussion of force issues in Canada and elsewhere, says Dr. Bill Lewinski, executive director of the Force Science Research Center at Minnesota State University-Mankato.

Hopefully, the researchers will now be encouraged to probe further into some of the issues they touched on, exploring in greater depth the decision-making that led officers to apply various types of force, the level of emotional and physical intensity generated by subjects receiving the force, the causes of injuries to both officers and subjects, and so on. There is still much to be learned in these areas.

As part of their study, Hall and Butler compiled statistics on the broad overview of force encounters among Calgary officers, which closely mirror findings regarding U.S. law enforcement.

For instance:

- Out of more than 827,000 police-public interactions, the 562 instances which ended up involving use of force represented less than 1% (.07%) of the total.

(Other studies have pegged that figure in the U.S. at 1.5%.)

- Arrests occurred in only 4.6% of police-public interactions, and 98.5% of the time the arrests were finessed without force.
- Roughly 88% of all subjects requiring force were under the influence of drugs and/or alcohol or ?some degree of emotional illness.? Almost 94% of resistant offenders requiring force were male.
- The researchers found ?a notable pattern of relationship?between the number of officers present and the frequency and nature of injuries sustained by both citizens and officers.? Namely: ?[M]ore injuries occurred in circumstances where only one officer was present.?

The researchers state bluntly that ?biased reporting of events has led the lay-public to have the impression that the police use of force is frequent when compared to the overall number of police and public interactions.?

They mentioned also a bias that results in ?extensive media coverage of events where subjects have died? after use of a CEW and a ?lack of publication of CEW uses without an adverse outcome.?

Such skewed reporting ?prevents the public?from forming an informed opinion about the actual risk presented? by various force modalities, they stated.

The study?s official jaw-breaking title is: ?Public-Police Interaction and Its Relation to Arrest and Use of Force by Police and Resulting Injuries to Subjects and Officers; a Description of Risk in One Major Canadian Urban City.? It is expected to be posted online in mid- to late-August by the Canadian Police Research Center at www.cprc.org

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Visit www.forcesciencenews.com for more information

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Research in Brief



Police Use of Force, Tasers and Other Less-Lethal Weapons

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Police Use of Force, Tasers and Other Less-Lethal Weapons

Findings and conclusions of the research reported here are those of the authors and do not necessarily reflect the official positions or policies of the U.S. Department of Justice.

This Research in Brief is based primarily on "A Multi-Method Evaluation of Police Use of Force Outcomes," final report to the National Institute of Justice, July 2010, NCJ 231176, available online at <http://www.ncjrs.gov/pdffiles1/nij/grants/231176.pdf>.

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ABOUT THIS REPORT

This study looked at injuries that occur to law enforcement officers and citizens during use-of-force events. Most applications of force are minimal, with officers using their hands, arms or bodies to push or pull against a suspect to gain control. Officers are also trained to use various other force techniques and weapons to overcome resistance. These include less-lethal weapons such as pepper spray, batons or conducted energy devices (CEDs) such as Tasers. They can also use firearms to defend themselves or others against threats of death or serious bodily injuries.

What did the researchers find?

This study found that when officers used force, injury rates to citizens ranged from 17 to 64 percent, depending on the agency, while officer injury rates ranged from 10 to 20 percent. Most injuries involve minor bruises, strains and abrasions.

The study's most significant finding is that, while results were not uniform across all agencies, the use of pepper spray and CEDs can significantly reduce injuries to suspects and the use of CEDs can decrease injuries to officers.

The researchers assert that all injuries must be taken seriously. When police in a democracy use force and injury results, concern about police abuse arises, lawsuits often follow and the reputation of the police is threatened. Injuries also cost money in medical bills for indigent suspects, workers' compensation claims for injured officers or damages paid out in legal settlements or judgments.

What were the study's limitations?

In many cases, agency-supplied injury data did not allow for a detailed analysis of the nature or seriousness of the injuries reported.



POLICE USE OF FORCE

*Geoffrey P. Alpert, Michael R. Smith, Robert J. Kaminski,
Lorie A. Fridell, John MacDonald, and Bruce Kubu*

Police Use of Force, Tasers and Other Less-Lethal Weapons

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Introduction

Police weaponry has come full circle.

During the middle of the 19th century, police officers in New York and Boston relied on less-lethal weapons, mostly wooden clubs. By late in the century, police departments began issuing firearms to officers in response to better armed criminals. Although firearms are still standard issue, law enforcement agencies are again stressing the use of less-lethal weapons rather than firearms.¹

The Fourth Amendment forbids unreasonable searches and seizures, and various other legal and policy controls govern how and when officers can use force. Most agencies tightly control the use of force and supervisors or internal affairs units routinely review serious incidents. New technologies have added to the concerns about the use of force by law enforcement.

New technologies raise questions

During the past 20 years, new technologies have emerged that offer the promise of more effective control over resistive suspects with fewer or less serious injuries. Pepper spray was among the first of these newer less-lethal weapons to achieve widespread adoption by police forces, and more recently, conducted energy devices (CEDs) such as the Taser have become popular.

Taser use has increased in recent years. More than 15,000 law enforcement and military agencies use them. Tasers have caused controversy (as did pepper spray) and have been associated with in-custody deaths and allegations of overuse and intentional abuse. Organizations such as Amnesty International and the American Civil Liberties Union have questioned whether Tasers can be used safely, and what role their use plays in injuries and in-custody deaths.



Several studies found that when agencies adopted the use of pepper spray, they subsequently had large declines in assaults on officers and declines in officer and suspect injury rates, and associated injuries were usually minor. Pepper spray provides a way to reduce injuries.

CEDs such as Tasers produce 50,000 volts of electricity. The electricity stuns and temporarily disables people by causing involuntary muscle contractions. This makes people easier to arrest or subdue. When CEDs cause involuntary muscle contractions, the contractions cause people to fall. Some people have experienced serious head injuries or bone breaks from the falls, and at least six deaths have occurred because of head injuries suffered during falls following CED exposure. More than 200 Americans have died after being shocked by Tasers. Some were normal, healthy adults; others were chemically dependent or had heart disease or mental illness.²

Tasers use compressed nitrogen to fire two barbed probes (which are sometimes called darts) at suspects. Electricity travels along thin wires attached to the probes. (A new wireless Taser is also on the market.) Darts may cause puncture wounds or burns. A puncture wound to the eye could cause blindness.³

Despite the dangers, most CED shocks produce no serious injuries. A study by Wake Forest University researchers found that 99.7 percent of people who were shocked by

CEDs suffered no injuries or minor injuries only. A small number suffered significant and potentially lethal injuries.

This NIJ-sponsored study included six police departments and evaluated the results of 962 "real world" CED uses. Skin punctures from CED probes were common, accounting for 83 percent of mild injuries.⁴

Policymakers and law enforcement officials want to know whether Tasers are safe and effective, and how (if at all) they should be used to match police use-of-force choices with levels of suspect resistance. This study indicates that CED use actually decreases the likelihood of suspect injury.

Previous research on use of force and injuries

The controversy around Taser use is not unique. Law enforcement agencies found themselves in similar circumstances with pepper spray in the 1990s. Human rights groups such as Amnesty International questioned the safety and misuse of pepper spray as its use spread rapidly in American law enforcement agencies. NIJ

funded various studies on the safety and effectiveness of pepper spray.⁵

Some studies have focused on officer injury. Several found that about 10 percent of officers were injured when force was used.⁶ However, two studies of major police departments found officer injury rates of 38 and 25 percent.⁷ The agencies with lower rates allowed officers to use pepper spray, while the two with higher rates did not.

A few researchers have looked at how various approaches to force affect officer injury rates.⁸ Overall, the empirical evidence shows that getting close to suspects to use hands-on tactics increases the likelihood of officer injuries. Research also shows that suspects have a higher likelihood of injury when officers use canines, bodily force or impact weapons such as batons. Alternatives to bodily force and impact weapons are found in other less-lethal weapons such as pepper spray and CEDs.

Previous studies on pepper spray and CEDs

Pepper spray. Law enforcement agencies rapidly

adopted pepper spray in the late 1980s and early 1990s as an alternative to traditional chemical agents such as tear gas, but its use sparked controversy. Notably, the American Civil Liberties Union of Southern California asserted that pepper spray was causing in-custody deaths. NIJ studies on the link between pepper spray and in-custody deaths found that the deaths were largely a result of positional asphyxia, pre-existing health conditions or were drug related.⁹

Several studies found that when agencies adopted the use of pepper spray, they subsequently had large declines in assaults on officers and declines in officer and suspect injury rates, and associated injuries were usually minor.¹⁰ Pepper spray provides a way to reduce injuries.

CEDs. Many law enforcement agencies noted that injury rates for officers and suspects declined after they introduced CEDs.¹¹

Medical research, including controlled animal trials and controlled human trials, has produced various insights. Some animal studies were conducted to learn if CED



use could result in ventricular fibrillation. Several studies showed that standard shocks that lasted five to 15 seconds did not induce ventricular fibrillation of the heart. Higher discharges, 15 to 20 times the standard, or those of longer duration — two 40-second exposures — induced fibrillation or increased heart rhythm in some pigs. In addition, longer exposures led to ventricular fibrillation-induced death in three pigs.¹²

Controlled studies involving healthy human subjects (often law enforcement trainees) found that subjects experienced significant increases in heart rates following exposure, but none experienced ventricular fibrillation.¹³

NIJ study and recommendations

NIJ gathered an expert panel of medical professionals to study in-custody deaths related to CEDs. In its report, the panel said that while CED use is not risk free, there is no clear medical evidence that shows a high risk of serious injury or death from the direct effects of CEDs. Field experience with CED use shows that exposure is usually safe. Therefore,

law enforcement agencies need not avoid using CEDs provided they are used in line with accepted national guidelines.¹⁴

A preliminary review of deaths following CED exposure found that many are associated with continuous or repeated shocks. There may be circumstances in which repeated or continuous exposure is required, but law enforcement officers should be aware that the associated risks are unknown. Therefore, caution is urged in using multiple activations.¹⁵

The seeming safety margins of CED use on normal healthy adults may not be applicable to small children, those with diseased hearts, the elderly, those who are pregnant and other at-risk people. The use of CEDs against these populations (when recognized) should be avoided, but may be necessary if conditions exclude other reasonable choices.¹⁶

A suspect's underlying medical conditions may be responsible for behavior that leads law enforcement officers to subdue him or her. Sometimes this includes CED use. Abnormal mental status in a combative or resistive subject, sometimes called

"excited delirium," may be associated with a risk for sudden death. This should be treated as a medical emergency.¹⁷

The national survey

The Police Executive Research Forum conducted a survey of state, county and municipal law enforcement agencies to learn more about less-lethal technologies and related policies and training. More than 500 agencies participated.

Most agencies have a "use-of-force continuum" that is covered in training, where officers learn to use suitable force levels depending on circumstances. For example, an officer might start by using verbal commands when dealing with a suspect. Then an officer might move to soft empty-hand tactics (such as pushing) when faced with lack of cooperation or mild resistance. The continuum covers various circumstances up to the use of firearms.

The survey included various levels of resistance and asked agencies to describe what force they allow in each. Most agencies allow only soft tactics against a subject who refuses, without physical force, to comply

with commands. Just under half allow officers to use chemical weapons at that point. However, if the subject tensed and pulled when an officer tried to handcuff him or her, most agencies would allow chemical agents and hard empty-hand tactics, such as punching. Many also allow for CED use at this point but about 40 percent do not. Almost three-fourths allow CED use if the suspect flees, and almost all allow it when the subject assumes a boxer's stance. Most agencies do not allow baton use until the subject threatens the officer by assuming the boxer's stance.

Three-fourths of the surveyed agencies that use CEDs issued them between 2004 and 2006. Most are using Tasers. In most agencies, officers receive four or six hours of training, and 63.7 percent of agencies require that officers experience activation (i.e., get shocked) during training.

Most agencies do not allow CED use against a subject who nonviolently refuses to comply with commands. However, six in 10 allow for CED use against a subject who tenses and pulls when the officer tries to handcuff him or her. Agencies usually

The seeming safety margins of CED use on normal healthy adults may not be applicable to small children, those with diseased hearts, the elderly, those who are pregnant and other at-risk people. The use of CEDs against these populations (when recognized) should be avoided but may be necessary if conditions exclude other reasonable choices.



place the CED with chemical agents in their force continuum, meaning that their use is typically approved in the same circumstances in which pepper spray use is allowed. CEDs are usually lower on the continuum than impact weapons.

One facet of the controversy surrounding CED use concerns vulnerable populations and circumstances that pose potentially heightened risk to the subject. For only one circumstance — when a subject is near flammable substances — do most agencies (69.6 percent) ban CED use.

Some 31 percent forbid CED use against clearly pregnant women, 25.9 percent against drivers of moving vehicles, 23.3 percent against handcuffed suspects, 23.2 percent against people in elevated areas and 10 percent against the elderly. However, many agencies, while not forbidding use in these circumstances, do restrict CED use except in necessary, special circumstances.

Analysis of information from specific law enforcement agencies

Looking at the experiences of specific agencies can yield important information that might otherwise be lost in larger analyses. The researchers used various statistical techniques to identify factors that increase or decrease the odds of injury to officers and suspects alike.

Richland County Sheriff's Department. The Richland County Sheriff's Department (RCSD) includes about 475 sworn officers who serve the unincorporated portions of Richland County, S.C. Deputies carry Glock .40 caliber pistols, collapsible metal batons and pepper spray. Increasingly, they also carry the model X-26 Taser. The agency started phasing in Taser use in late 2004. During data collection, about 60 percent of deputies carried Tasers.

Researchers coded 467 use-of-force reports covering the period from January 2005 to July 2006. Of the 49 separate injuries recorded for officers (three officers had more than one injury), 46 involved bruises, abrasions or cuts. The department recorded 92

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suspect injuries; 69 of those were bruises, abrasions or cuts. Most of the remaining suspect injuries were dog bites, but three involved broken bones or internal injuries.

Further analysis of the data included identifying how various factors increased or decreased the risk of injury to officers or suspects. The use of soft empty-hand techniques by an officer, active aggression by a suspect and suspect use of deadly force all increased the risk for deputies.

Soft empty-hand control was the most frequent force level used by deputies, occurring in 59 percent of all use-of-force incidents. These techniques increased the odds of officer injury by 160 percent. Thus, deputies were at greatest risk for injury when using the least force possible.

Two variables significantly decreased the risk for suspects. Pepper spray use decreased the odds of suspect injury by almost 70 percent, and a deputy aiming a gun at a suspect reduced injury odds by more than 80 percent (because the act of pointing a gun alone often effectively ends the suspect's resistance).

However, the use of a canine posed, by far, the greatest injury risk to suspects, increasing injury odds by almost 40 fold. Suspects who displayed active aggression toward deputies were also more likely to suffer injuries. CED use had no effect on the likelihood of injury; this is inconsistent with the experiences of other agencies, suggesting that not every agency's experience with the Taser will be the same.

Miami-Dade Police

Department. The department has about 3,000 officers, is the largest law enforcement agency in the Southeast and is one of the largest departments that has never issued pepper spray to its officers.¹⁸

The researchers examined 762 use-of-force incidents involving a lone officer and a lone suspect that occurred between January 2002 and May 2006. About 70 percent of the officers carried Tasers by May 2006. Officers were substantially less likely to be injured than suspects, with 16.6 percent (124) of officers injured and 56.3 percent (414) of suspects injured. Most injuries were minor, but 73 suspects (17 percent)

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suffered serious injuries. Minor injuries included bruises, sprains and lacerations. Major injuries included bites, punctures, broken bones, internal injuries and gunshot wounds.

The department does not issue pepper spray to its line officers, and there were few incidents involving guns or batons. Analysis of the incidents found that the use of both soft-hand tactics and hard-hand tactics by officers more than doubled the odds of officer injury. Conversely, CED use was associated with a 68-percent reduction in the odds of officer injury.

As for suspects, hands-on tactics increased the odds of injury, the use of canines greatly increased the odds and CED use substantially decreased the odds.

Seattle Police Department.

The Seattle Police Department has about 1,200 sworn officers. The agency started using Tasers in December 2000. Other less-lethal weapons include pepper spray, batons and shotgun beanbag rounds. The department recorded 676 use-of-force incidents between Dec. 1, 2005, and Oct. 7, 2006. Suspects suffered injuries in 64 percent of the

incidents, while officers suffered injuries in 20 percent of the incidents. Officers used hands-on tactics in 76 percent of the incidents. The next most frequent type of force officers used was the Taser (36 percent), followed by pepper spray (8 percent).

Suspects were impaired by alcohol, drugs or mental illness in 76 percent of the incidents. Just over half (52 percent) of the suspects were nonwhite, and 95 percent were male. Analysis of the data revealed that Taser use was associated with a 48-percent decrease in the odds of suspect injury but did not affect officer injury.

The use of unarmed tactics by officers increased the odds of officer injury 258 percent. The odds of officer injury increased significantly when suspects resisted using physical force or the use or threat of use of a weapon.

Although results were not uniform across the agencies, the analysis shows that the use of pepper spray and CEDs can have a significant and positive injury-reduction effect.

Interestingly, nonwhite suspects were less likely to be injured than whites in both

agencies (Miami and Seattle) where suspects' race was available as a variable for analysis. Another important finding concerns the use of canines. While canines were used rarely, their use substantially increased the risk of injury to suspects in two of the agencies.

Combined agency analysis and its limitations

The researchers also conducted a combined analysis of use-of-force data from 12 large local law enforcement agencies.¹⁹ The full report gives a detailed description of the information available and the limits of the data. Most agencies, for example, had details about demographic characteristics of suspects, but only four had officer demographic information. Moreover, the Miami-Dade Police Department did not use pepper spray while San Antonio did not use CEDs.

Despite the limitations, the study's use of a large sample, representing more than 25,000 use-of-force incidents, allowed the researchers to use statistical techniques in an effort to learn which variables are likely to affect injury rates to officers and suspects. The use of physical force (hands, feet, fists)

by officers increased the odds of injury to officers and suspects alike. However, pepper spray and CED use decreased the likelihood of suspect injury by 65 and 70 percent respectively. Officer injuries were unaffected by CED use, while the odds of officer injury increased about 21 percent with pepper spray use.

The researchers noted the 12-agency analysis yielded puzzling results about the relationship between pepper spray use and officer injury rates. Those results are inconsistent with the single agency analysis. More research may explain the differences.

Longitudinal analysis

The researchers reviewed use-of-force information from police departments in Austin, Texas, and Orlando, Fla., to learn how introducing CEDs affected injury rates. This quasi-experimental approach tracked injuries before and after CED introduction.

The Orlando data include 4,222 incidents covering 1998 to 2006. CED use began in February 2003. The Austin data includes 6,596 incidents from 2002 to 2006. However, CED use was



phased in beginning in 2003 and was not completed until June 2004. A large drop in injury rates for suspects and officers alike occurred in both cities following CED introduction.

In both cities, Taser adoption was associated with a statistically significant drop in average monthly injuries to suspects. In Orlando, the suspect injury rate dropped by more than 50 percent compared to the pre-Taser injury rate. In Austin, suspect injury rates were 30 percent lower after full-scale Taser deployment.

In Orlando, the decline in officer injury rates were even greater than for suspects; the average monthly rate dropped by 60 percent after Taser adoption. In Austin, officer injuries dropped by 25 percent.

Interviews with officers and suspects

Researchers conducted interviews with 219 officers from South Carolina's Richland County Sheriff's Department, 35 from the Columbia Police Department (CPD), and 35 suspects involved in use-of-force situations to supplement and add a qualitative context to their quantitative

analyses. Generally, they tried to contact officers and suspects within 48 hours of receiving a use-of-force report. Interviews were voluntary, and some officers and suspects declined to participate.

In nine out of 105 use-of-force incidents, Richland County Sheriff's Department officers reported that a Taser did not work properly or did not have the desired effect. In addition, researchers received reports of multiple Taser hits on a suspect and multiple uses of the Taser in "drive stun" mode (when the Taser is pressed against a suspect rather than firing darts) to control suspects (or, based on the suspects' reports, as punishment). These reports indicate that some officers are using Tasers multiple times during an encounter.

Nine percent of the officers reported injuries, almost all of which were scrapes, cuts or bruises suffered while struggling with resistant suspects. Officers also reported that 26 suspects (12 percent) were injured. Most suspect injuries were cuts or abrasions, but there were also two dog bites, and one suspect was shot in the arm after firing at officers.

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In 22 cases, researchers interviewed both the officers and suspects involved in an incident. Most suspects said officers used excessive or unnecessary force to subdue them. Some suspects said officers used Tasers quickly, and several said the officers enjoyed watching them endure the pain. Some suspects said officers kned them in the back and kicked or punched them after they were in handcuffs. Some also said officers used Tasers on them after they were handcuffed.

Suspects often tell a different story than the officers who arrest them. In almost all cases, suspects said officers used excessive force and that they were not resisting arrest. The officers, for their part, said they used minimal force to control suspects, and did not mention using force after a suspect was under control. Officers reported that the force used was necessary and reasonable. In a typical account, a suspect said he was unaware there was a warrant out for his arrest, and when police confronted him, he did not resist. He said the officers "pushed me to the ground and put the cuffs on ... they didn't have

to do that to me." He said that all the officers had to do was tell him to "quit acting up." He complained that officers should just have told him to calm down instead of pushing him to the ground. By contrast, they said the suspect ran away when confronted, so they tackled him. These kinds of contradictions were common; suspects said they did not resist, and officers provided justification for the force levels they used.

In other cases, suspects and officers offered radically different versions of events. For example, in one case, an officer said he saw several traffic violations and the suspects sped off and stopped, with one suspect running away. The officers said the driver then tried to exit the vehicle from the passenger's side holding a shotgun. One officer pointed his weapon at the suspect, who then dropped the shotgun. The suspect failed to mention the shotgun to researchers and only complained that officers put the handcuffs on too tightly and slammed him around in the back of the transport vehicle.

Unlike the Richland County Sheriff's Department, the



Columbia Police Department did not use Tasers. The officers described 35 use-of-force incidents. Three officers reported that pepper spray was ineffective. In all three cases, the suspects were either drunk or high on drugs. One case, in particular, highlighted the potential advantages of the Taser over pepper spray in some circumstances. In that case, a 6'7", 370-pound man wanted for domestic violence charged an officer with a metal object in his hand. The officer used pepper spray, but it had no effect. The suspect then retreated to the apartment kitchen and grabbed a knife. The officers pointed their guns at him and ordered him to drop the knife, but he refused. He cut and stabbed himself with the knife while the officers waited for another agency to arrive that was equipped with a Taser. The suspect cut himself more than 100 times before the South Carolina Law Enforcement Division arrived and used a Taser on him. The Taser had an instant effect, and officers were then able to handcuff the suspect.

Most injuries in both agencies occurred when officers and suspects struggled on

the ground. The differences between the agencies were striking. RCSD equips most of its deputies with Tasers. The deputies collectively reported fewer injuries to themselves and suspects from ground fighting than did CPD officers. CPD did not issue Tasers, and 31 percent of its officers reported getting cuts, scrapes and bruises from wrestling with suspects on the ground. The prevalence of ground fighting injuries among RCSD officers (less than nine percent) was lower, as were injuries to suspects caused by contact with the ground. Some of the injuries could have been prevented had officers used Tasers instead of hands-on tactics.

Implications for policy, training and future research

Because of the controversial nature and widespread use of CEDs, the researchers explored their use in detail and made recommendations, based on the findings, for whether and how CEDs should fit into the range of less-lethal force alternatives available to law enforcement officers.

Factors affecting injuries

Physical force

The findings clearly show the use of physical force and hands-on control increase the risk of injury to officers and suspects. In Richland County, S.C., soft empty-hand control significantly increased the odds of injury to officers, while hard empty-hand tactics increased the risk of injury to suspects. In Miami-Dade, both types of force increased the risk of injury to both officers and suspects. In Seattle, use of force increased injury risk to officers but not to suspects, while the overall analysis (of 12 agencies) showed increased injury risk to suspects and especially to officers associated with physical force. This increased risk was large. When controlling for the use of CEDs and pepper spray in the overall analysis, using force increased the injury odds to officers by more than 300 percent and to suspects by more than 50 percent.

Suspect resistance

Increasing levels of suspect resistance were associated with an increased risk of

injury to officers and suspects. The increased injury risk was especially acute for officers. In Richland County, active aggression and threats of deadly force increased the odds of officer injury by more than 100 percent. The odds of suspect injury were unchanged in Seattle with increased resistance levels. These findings suggest that officers, rather than suspects, face the most increased injury risk when suspects resist more vigorously.

Pepper spray

The findings suggest that, at least for suspects, pepper spray use reduces the likelihood of injury. In Richland County, pepper spray use reduced the odds of suspect injury by 70 percent but did not affect officer injuries. In Seattle, pepper spray use had no effect on injury rates for officers or suspects. However, the overall analysis (of 12 agencies) showed that pepper spray use reduced the likelihood of injury to suspects by 70 percent, which was even more than the decline noted with CEDs (see below). For officers, pepper spray use increased the likelihood of injury by 21 to 39 percent. This finding



was unexpected, and more research may help to explain how officers choose to use pepper spray versus CEDs.

CEDs

Except for in Richland County where its effects were insignificant, CED use substantially decreased the likelihood of suspect injury. In Miami-Dade, the odds of a suspect being injured were almost 90 percent lower when a CED was used than when it was not. Similarly, the odds of suspect injury went down by almost 50 percent when CEDs were used in Seattle. The larger analysis of 12 agencies and more than 24,000 use-of-force cases showed the odds of suspect injury decreased by almost 60 percent when a CED was used. In Richland County, Seattle, and in the larger analysis, Taser use had no effect on officer injuries, while in Miami-Dade, officer injuries were less likely when a Taser was used. Controlling for other types of force and resistance, CED use significantly reduced the likelihood of injuries. CED adoption by the Orlando and Austin police departments reduced injuries to suspects and officers over time.

Demographic characteristics

Apart from officer force and suspect resistance, few other factors influenced injury outcomes. In Miami-Dade, male suspects were twice as likely to be injured as females. The same held true for the 12-agency analysis. In that larger analysis, the presence of a male suspect slightly increased injury risk to officers. In Seattle, female officers were more than twice as likely to be injured as male officers.

Placement of pepper spray and CEDs on a linear use-of-force continuum

People rarely die after being pepper sprayed or shocked with a Taser. However, if injury reduction is the primary goal, agencies that allow use of these less-lethal weapons are clearly at an advantage. Both weapons prevent or minimize the physical struggles that are likely to injure officers and suspects alike. Although both cause pain, they reduce injuries, and according to current medical research, death or serious harm associated with their

use is rare. In that sense, both are safe and similarly effective at reducing injuries. Both should be allowed as possible responses to defensive or higher levels of suspect resistance. This recommendation is supported by the findings and is now followed by most agencies that responded to the national survey.

Policy and training issues related to CEDs

CEDs were used far more often (four to five times more often) than pepper spray among agencies that equipped officers with CEDs and were sometimes used at rates that exceeded empty-hand control. Unlike pepper spray, CEDs do not require decontamination and do not carry the risk of accidental “blow back” that often occurs with pepper spray use. However, they do entail the removal of prongs and the potential for an unintended shock to an officer. Even with these concerns, they are rapidly overtaking other force alternatives. Although the injury findings suggest that substituting CEDs for physical control tactics may be useful, their ease of use and popularity among officers raise the specter of overuse.

The possible overuse of CEDs has several dimensions. CEDs can be used inappropriately at low levels of suspect resistance. Law enforcement executives can manage this problem with policies, training, monitoring and accountability systems that provide clear guidance (and consequences) to officers regarding when and under what circumstances CEDs should be used, or when they should not be used.

Besides setting the resistance threshold appropriately, good policies and training would require that officers evaluate the age, size, gender, apparent physical capabilities and health concerns of a suspect. In addition, policies and training should prohibit CED use in the presence of flammable liquids or in circumstances where falling would pose unreasonable risks to the suspect (in elevated areas, adjacent to traffic, etc.). Policies and training should address the use of CEDs on suspects who are controlled (e.g., handcuffed or otherwise restrained) and should either prohibit such use outright or limit them to clearly defined, aggravated circumstances.



In addition to being used too often, CEDs can be used too much. Deaths associated with CED use often involve multiple Taser activations (more than one Taser at a time) or multiple five-second cycles from a single Taser. CED policies should require officers to assess continued resistance after each standard cycle and should limit use to no more than three standard cycles. Following CED deployment, the suspect should be carefully observed for signs of distress and should be medically evaluated at the earliest opportunity.

Directions for future research

CEDs can be used too much and too often. A critical research question focuses on the possibility of officers becoming too reliant on CEDs. During interviews with officers and trainers, the researchers heard comments that hinted at a "lazy cop" syndrome. Some officers may turn to a CED too early in an encounter and may relying on a CED rather than rely on the officer's conflict resolution skills or even necessary hands-on applications. Research should explore how officers who have CEDs perceive threats,

compared to officers who do not have them. In addition, it is important to determine when, during an encounter, an officer deploys the CED.

Another important CED-related research project would be a case study of in-custody deaths involving CED use and a matched sample of in-custody deaths when no CED use occurred. Advocacy groups argue that CEDs can cause or contribute to suspect deaths. The subjects in CED experimental settings have all been healthy people in relatively good physical condition who are not under the influence of alcohol or drugs. There is no ethical way to expose overweight suspects who have been fighting or using drugs to the effects of CEDs, so an examination of cases where similar subjects lived and died may shed some light on the reasons for the deaths. Law enforcement officials typically argue that most if not all the subjects who died when shocked by a CED would have died if the officers had controlled and arrested them in a more traditional hands-on fight. At this point, the argument is rhetorical and research is needed to understand the differences and similarities in cases where suspects died

in police custody, including deaths where a CED may or may not have been involved.

Finally, female officers in Seattle were more than twice as likely to suffer injuries as males. Perhaps the finding in Seattle is an anomaly, but it should be investigated further.

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18. The MDPD provides police services to the unincorporated areas of Miami-Dade County, Fla., which together contain more than 1 million people in a 1,840 square mile area.
19. The agencies included police and sheriff's departments in Austin, Texas; Cincinnati, Ohio; Harris County, Texas; Hillsborough County, Fla.; Los Angeles (both the city and the county); Miami-Dade, Fla.; Nashville, Tenn.; Orlando, Fla.; Richland County, S.C.; San Antonio, Texas; and Seattle, Wash.

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Study of Deaths Following Electro Muscular Disruption

The risk of death in a CED-related use-of-force incident is less than 0.25 percent, and it is reasonable to conclude that CEDs do not cause or contribute to death in the large majority of those cases. (pg. viii)

Unlike the risk of secondary injury due to falling or puncture, the risk of human death due directly or primarily to the electrical effects of CED application has not been conclusively demonstrated. However, there are anecdotal cases where no other significant risk factor for death is known. Additionally, current research does not support a substantially increased risk of cardiac arrhythmia in field situations, even if the CED darts strike the front of the chest. (pg. viii)

In formulating the findings reported here, the panel conducted mortality reviews of CED-related deaths and reviewed the current state of medical research relative to the effects of CEDs. The panel considered nearly 300 CED-related deaths. In these incidents, (a) CED(s) was (were) deployed by (a) law enforcement officer(s) on an individual who later died. In the vast majority of these cases, the original medicolegal investigation concluded that the CED played no role in the death. The panel concentrated its review on those cases in which a CED was listed on the death certificate. (pg. 1)

Field experience with CED use indicates that exposure is safe in the vast majority of cases.^{4,6} One prospective study observed a 0.25 percent risk of serious injury (head trauma or rhabdomyolysis) with CED use, much less than that observed for other subdual options.⁶ Other studies also indicate that CED-related injuries and deaths are uncommon, especially in comparison to other force options.⁷ One review showed that officer and subject injury rates were much lower during CED use compared to use of empty-handed physical skills, incapacitating spray or batons, while another indicated that injury rates were substantially lower with the use of incapacitating sprays and CEDs.^{1,8} (pg. 3)

It should be noted that arrestees who are involved in use-of-force incidents are by nature at higher risk for serious complication and death relative to the overall population. These individuals are more likely to be drug-intoxicated, be mentally ill or have serious underlying medical conditions.⁶ There are more than 600 arrest-related deaths in the United States each year and roughly 1 million incidents in which police use or threaten to use force.^{9,10} Nonetheless, the CED is cited as a causative or contributory factor in very few arrest-related deaths each year.⁹ In this context, the relative risk of CED deployments appears to be lower than other use-of-force options. (pg. 3)

There is no conclusive medical evidence within the state of current research that indicates a high risk of serious injury or death from the direct or indirect cardiovascular or metabolic effects of short-term CED exposure in healthy, normal, nonstressed, nonintoxicated persons.¹¹ Current medical research in humans and animals suggests that a single exposure of less than 15 seconds from a TASER[®] X-26[™] or similar model CED is not a stress of a magnitude that separates it from the other stress-inducing components of restraint or subdual.¹² (pg. 3)

Based on cases reviewed by this panel, most adverse reactions and deaths associated with CED deployment appear to be associated with multiple or prolonged discharges of the weapons. There is

limited research with regard to exposures of greater than 15 seconds.^{13,14} Further, extended CED exposure may not be effective in the subdual of some individuals with high levels of drug intoxication or mental illness. (pg. 3)

Conclusions and Recommendations:

In summary, the risk of moderate or severe injury or death from a CED exposure, whether the injury is directly due to darts or indirectly due to secondary events (falls, fractures, etc.) is probably less than 1 percent. Evidence from use in the field has shown that the risk of death in a CED-related incident is $\leq$ 0.25 percent.² These studies do not conclude that all the deaths were attributable to CED use. The panel views this as an acceptable level of risk when potential benefits of CED use are considered, such as reductions of serious injuries to suspects and law enforcement officers and the risk associated with other lethal and less-lethal options, when used in accordance with appropriate agency policies. (pg. 4)

There is currently no medical evidence that CEDs pose a significant risk for induced cardiac dysrhythmia in humans when deployed reasonably. The heart rhythm issues most important to consider are ventricular fibrillation (VF), ventricular capture (pacing), ventricular tachycardia (VT), atrial fibrillation and pulseless electrical activity (PEA). (pg. 9)

There is one case report in the medical literature documenting VF two minutes after the collapse of a teenager who was subdued with a CED.⁵ The proximity of this collapse to CED use and documented VF argues in favor of an electrically induced cardiac event. A recent review of in-custody deaths associated with CED use evaluated individuals who collapsed within 15 minutes of exposure.⁶ Presenting rhythms were available in 56 subjects. In 52 subjects bradycardia-asystole or PEA was seen. The rhythm was VF in four subjects (7 percent). Only one patient collapsed within one minute of exposure, as would typically be expected with VF. Two had a more delayed collapse at five to eight minutes, and one collapsed before exposure. In-custody deaths rarely occur immediately following use of the device, but occur more typically minutes to hours later.⁷ Because a VF-related death would be expected to be almost immediate, VF is unlikely to be the cause in most of these in-custody deaths. (pg. 9)

There is a multitude of ECG and cardiac enzyme data in the literature supporting no significant long-term effects on the heart by CED use. Autopsies have not demonstrated evidence of myocardial infarction (heart attack). The available data do not show long-term blood chemistry changes affecting cardiac function. There are some recent data demonstrating significant increase in blood acidity (acidosis) in animal models after CED use.²¹ Some research has examined the role of exertion in combination with CED effects. Extreme physical exertion causes an increase in acidosis because of the production of lactate in the muscles. Severe acidosis can cause spontaneous dysrhythmias that would not be a direct effect of CED use.³² Additionally, severe acidosis can lead to pulseless electrical activity which may be a mechanism of sudden death seen after a prolonged struggle. CED exposure does not appear to worsen the acidosis that is present from exertion alone. (pg. 11)

There is a controversial case report of the successful resuscitation of a teenager with bipolar disorder and polysubstance abuse who was subdued with a CED. He was reportedly found not to be moving approximately 20 minutes after CED exposure. Emergency medical services personnel found him to be in asystole shortly thereafter. The individual was resuscitated and eventually discharged from the hospital with no apparent long-term deficits.³⁶ In one publication, bradycardia-asystole or PEA was seen in 93

percent of sudden deaths which quickly followed discharge of CEDs⁶. Either of these dysrhythmias can be precipitated by severe acidosis or could be the terminal rhythm following another life-threatening rhythm. It remains unclear if CED use contributes to the development of PEA or asystole. (pg. 11)

Although sudden death occurs in custody with and without the use of CED, the exact mechanism of death in many cases is often not clear.^{7,37,38} Sometimes, individuals who have been restrained or are in the process of being subdued will stop moving or responding. In many cases, the individual may simply be passively compliant. In some cases, the individual may be experiencing a medical emergency related to acidosis, respiratory compromise, or cardiac arrhythmia. Therefore, the restrained individual should be constantly monitored for responsiveness and general medical condition. (pg. 11)

Conclusions and Recommendations:

Law enforcement personnel are trained to target center body mass when using CEDs. TASER[®] International, Inc., (a major CED manufacturer) has recently recommended a change in target zone to below the chest. TASER[®] Bulletin 15 states, "By simply lowering the preferred target zone by a few inches to lower center mass, the goal of achieving Neuro Muscular Incapacitation (NMI) can be achieved more effectively while also improving risk management."³⁹ The panel does recognize that CED use involving the area of the chest in front of the heart area is not totally risk-free; current research does not support a substantially increased risk of cardiac dysrhythmia in field situations from anterior chest CED dart penetrations. (pg. 13)

The balance of acid and base in the body is maintained by the respiratory system and the kidneys. These respond to the metabolic demands of the individual. As with rigorous exercise, the CED causes muscle contractions that produce lactate in the blood. Lactate lowers the pH of blood, making it more acidic. (pg. 15)

Research to date, however, shows that human subjects seem to maintain the ability to breathe during exposure to a CED. In fact most evidence suggests hyperventilation with an increase in respiratory rate, tidal volume, and minute ventilation during CED exposure. Direct observation of diaphragmatic movement was seen in one study.¹ (pg. 15)

Significant acidosis can lead to pulseless electrical activity and may be a mechanism of sudden death in custody. Of particular concern is the possible role that systemic acidosis may play in addition to any metabolic abnormalities or drug intoxication seen in excited delirium, as discussed elsewhere in this report. (pg. 16)

Whenever law enforcement officers subdue or restrain an individual, they are contributing to the person's stress level. All aspects of an altercation (including verbal altercation, flight, physical struggle, or physical restraint) constitute stress that may heighten the risk of sudden death, generally from a cardiac dysrhythmia. Whether or not a CED deployment is involved and regardless of the intent of the officer, it is possible for the actions of an officer to directly or indirectly contribute to death by inducing stress. Stress induced by the criminal action of others may be considered a contributing factor in initiating the mechanism of death in certain individuals with underlying natural disease. (pg. 18)

An important question is whether or not stress caused by CED exposure is different enough from other forms of stress during the agitation, restraint or subdual to justify its separate consideration when certifying death. (pg. 18)

The data used to address the stress issue have been derived largely from prospective studies conducted on human volunteers. Medical research suggests that a single exposure of less than 15 seconds deployed from a TASER[®] model X26[™] or a similar model CED is not a stress of a magnitude which separates it from the other stress-inducing components of restraint or subdual.⁴ (pg. 18)

It has been proposed that acute stress can damage the heart muscle. There are several reports that suggest that acute stress (with catecholamine release) may cause a cardiomyopathy (or disease of the heart muscle) and be induced in certain individuals during police confrontation. There are insufficient data to provide diagnostic criteria for such a syndrome, although some research and case reports exist.⁸⁻¹¹ Japanese cardiologists initially described “acute stress cardiomyopathy” with transient left ventricular apical ballooning and normal coronary vessels in otherwise healthy, asymptomatic individuals who died in police custody.⁸ Such deaths occurred in the absence of CED exposure and are believed to involve a sudden cardiac dysrhythmia induced by a surge in adrenaline. Other studies of CED exposure have examined parameters such as blood chemistry, cardiac enzymes and blood gases.^{5,12,13} Although studies on human volunteers undergoing prolonged (greater than 15 second) CED exposure showed statistically significant changes in blood gases, these changes (or any respiratory impairment) appear to have limited clinical significance in these healthy individuals.^{13,16} (pg. 19)

Further study is needed to determine the quantity of stress caused by prolonged or repetitive CED exposure in normal subjects, and larger numbers of human subjects need to be tested. Similar studies in persons with significant disease or drug intoxication would provide more useful data. However, it is not ethical to conduct human studies which attempt to replicate certain “field conditions” (such as drug intoxication with agitation) encountered in CED-associated, police confrontation deaths. The fatal mechanisms of stress and catecholamine release need further clarification, and methods to measure and quantify stress effects should be investigated. Until such methods are developed or more comprehensive field data are obtained, it is reasonable to infer that the effects of acute stress can be cumulative, and that the cumulative effects of adrenaline and other factors such as acidosis may increase an individual’s risk of experiencing a sudden cardiac dysrhythmia. (pg. 19)

CED exposure may contribute to “stress,” and stress may be an issue related to cause-of death determination. All aspects of an altercation (including verbal altercation, physical struggle or physical restraint) constitute stress that may heighten the risk of sudden death in individuals who are intoxicated or who have pre-existing cardiac or other significant disease. Medical research suggests that CED deployment during restraint or subdual is not a contributor to stress of a magnitude that separates it from the other stress-inducing components of restraint or subdual.¹⁵ (pg. 19)

Excited delirium (ExD) 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.¹⁻³ ExD-associated agitated behavior often leads to law enforcement intervention and CED use. The predominant theory of the underlying etiology of ExD is an excess of catecholamines (such as

adrenaline) or sympathetic nerve stimulation during the excited period. However, a syndrome, by definition, is a collection of signs and symptoms, not a specific disease. People with multiple conditions may present in this manner, including drug-induced psychosis, serotonin syndrome, diabetic ketoacidosis, paranoid schizophrenia and others. Alcohol withdrawal and head trauma have also been implicated.⁴ Recent research suggests that individuals with a history of chronic illicit stimulant abuse may be particularly susceptible to excited delirium.⁵ (pg. 21)

Excited delirium (ExD) 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.¹⁻³ ExD-associated agitated behavior often leads to law enforcement intervention and CED use. The predominant theory of the underlying etiology of ExD is an excess of catecholamines (such as adrenaline) or sympathetic nerve stimulation during the excited period. However, a syndrome, by definition, is a collection of signs and symptoms, not a specific disease. People with multiple conditions may present in this manner, including drug-induced psychosis, serotonin syndrome, diabetic ketoacidosis, paranoid schizophrenia and others. Alcohol withdrawal and head trauma have also been implicated.⁴ Recent research suggests that individuals with a history of chronic illicit stimulant abuse may be particularly susceptible to excited delirium.⁵

There is ongoing research in how best to manage patients with ExD. However, it is clear that at least some of these patients are medically unstable and in a rapidly declining state with a risk of mortality in the short term. This holds true even with medical intervention or in the absence of CED deployment or other types of subdual. While studies in young, healthy, drug-free volunteers suggest that CED deployment has inconsequential metabolic and stress-related effects, no human studies have been performed in situations modeling ExD.¹⁰ (pg. 21-22)

Most fatalities involving CED use are in people who have other risk factors for sudden death. This is a concern for law enforcement, because a large number of arrestees will have unrecognized clinical states of drug intoxication or pre-existing medical conditions that put them at risk for sudden, unexpected death, regardless of the type of subdual or restraint used. The medicolegal death investigator must identify the currently recognized safety margins of CED deployment in order to evaluate competing possible causes of death. Most of the deaths reviewed by the panel for this report involved individuals with drug intoxications or complicating medical conditions or both, thus making judgments about the relative role of CED exposure in the deaths very difficult. (pg. 23)

The use of manual techniques, baton blows, CEDs, other less-lethal technologies and even taking no action at all will each carry its own risks. All evidence suggests that the use of CEDs 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. The decision to use a CED or other options is best left to the reasonable tactical judgment of trained law enforcement at the scene. (pg. 24)

There is no evidence in animals that indicates a high risk of injury from a single discharge lasting less than 15 seconds from a TASER[®] X26[™]. Unlike the TASER[®] X26[™], which requires the user to hold the trigger to maintain discharges longer than five seconds, other CEDs will apply a longer discharge without

any intervention from the user. The TASER[®] C2[™], designed for civilian use, applies a 30-second exposure to a target. Thirty-second exposure to the output of the TASER[®] C2[™] CED in swine resulted in significant changes in blood chemistry, although most of the blood changes returned to baseline after the CED discharge ended. This raises concern for potential detrimental effects due to use of the TASER C2[™] CED.¹ However, in one study, 20-to 30-second C2[™] CED application in healthy humans had no significant deleterious effects on their physiology.² (pg. 26)

There is no standard definition of “prolonged” CED exposure for either continuous duration or number of multiple interrupted discharges. The majority (93 percent) of CED exposures in the field involve 15 seconds or less; a significant body of the medical literature has employed 15 seconds or less of CED exposure.³ (pg. 26)

After a review of anecdotes that seemed to indicate that multiple exposures were more hazardous, one researcher recommended in 2005 — without supporting documentation — that law enforcement agents should “... [l]imit the number of TASER[®] exposures when possible (3 is probably a reasonable number).”⁴ The Police Executive Research Forum produced guidelines for police concerning CED use including a recommendation that “[w]hen activating a CED, law enforcement officers should use it for one standard cycle and stop to evaluate the situation (a standard cycle is five seconds). If subsequent cycles are necessary, agency policy should restrict the number and duration of those cycles to the minimum activations necessary to place the subject in custody.”⁵ The Canadian Police Research Centre recommended: “... continuous cycling of the TASER for periods exceeding 15-20 seconds may increase the risk ... and should be avoided where practical.”⁶ (pg. 26)

Recommendations by the principal manufacturer, TASER[®] International Inc., have changed over time. Prior to 2008, they warned against extended duration applications [greater than 5 seconds], noting in particular that darts over the chest or diaphragm may impair respiration and cautioned that “... [u]sers should avoid prolonged, extended, uninterrupted discharges or extensive multiple discharges whenever practicable...”⁷ Their 2008 training bulletin (#14) concludes that more recent tests on humans demonstrate that “... there are no adverse effects on heart function or respiration deriving from multiple or prolonged deployments.”⁸ (pg. 26-27)

Review of deaths following CED exposure indicates that some are associated with prolonged or multiple discharges of the CED. By contrast, experiments using healthy human volunteers have found no cardiac dysrhythmias^{9,10} or respiratory dysfunction¹¹ following exposures less than 45 seconds. There are no published studies of humans exposed in excess of 45 seconds. Continuous 15 second application of the X26[™] to either the back or chest of “physically exhausted” adult humans (designed to mimic field situations), over a 12-inch anatomic spread encompassing the heart, yielded normal electrocardiograms.¹³ (pg. 27)

There may be circumstances in the field that require repeated or continuous exposure to a CED discharge. Law enforcement personnel should be aware that the associated risks are unknown and that most deaths associated with CED use involved multiple or prolonged discharges. Therefore, multiple

or prolonged activations of CED as a means to accomplish subdual should be minimized or avoided. (pg. 27)

In the largest independent study to date, involving 12 agencies and more than 24,000 use-of-force cases, the odds of suspect injury decreased by almost 60 percent when a CED was used.^{8,9} Officer injuries were either unaffected or reduced when a CED was used. In contrast, using physical force increased the odds of injury to officers by more than 300 percent and to suspects by more than 50 percent.^{8,9} In general, the outcome data are consistent with medical research and this panel's review of deaths following CED deployment. Deployment of CED has a margin of safety as great as or greater than most alternatives.¹²⁻¹⁴ (pg. 30)

Dart removal. In most cases, darts embedded in the skin may be removed at the scene by properly trained medical or law enforcement personnel in accordance with local protocols. (pg. 33)

The TASER X26 The manufacturer introduced its X26 model, for law enforcement and military use, in 2003. It was more compact, 60 percent lighter, and designed to be carried in a holster on an officer's service belt. The X26's specifications are similar to the M26, except for the following: (pg. 53)

- Batteries — digital power magazine (two 3-volt lithium batteries, as used in digital cameras)
- Pulse rate — 19 pulses per second
- Pulse duration — 100 microseconds (100 millionths of a second)
- Peak loaded voltage — 1,200 V
- Average voltage over duration of main phase — 400 V
- Average voltage over full phase — 350 V
- Average voltage over one second — 0.76 V
- Current — 2.1 mA average
- Energy per pulse:
 - Nominal at main capacitors — 0.36 joules
 - Delivered into load — 0.07 joules
- Power rating:
 - Nominal at main capacitors — 6.84 watts
 - Delivered into load — 1.33 watts

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REPORT

Study of Deaths Following Electro Muscular Disruption

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Modeling the Flow of Electro Muscular Disruption

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Executive Summary

Law enforcement agencies continue to seek alternatives to lethal force and better methods to subdue individuals in order to minimize injuries and death. Less-lethal technologies have been used by law enforcement for this purpose extensively since the early 1990s. As of spring 2010, conducted energy devices (CEDs) causing electro muscular disruption have been procured by more than 12,000 law enforcement agencies in the United States. Approximately 260,000 CEDs have been issued to law enforcement officers nationwide. Police adoption has been driven by two major beliefs: first, that CEDs effectively facilitate arrests when suspects actively resist law enforcement; second, that CEDs represent a safer alternative than other use-of-force methods. Studies by law enforcement agencies deploying CEDs have shown reduced injuries to both officers and suspects in use-of-force encounters and reduced use of deadly force. More recently, independent researchers have come to similar conclusions, when appropriate deployment and training policies are in place.

Nonetheless, a number of individuals have died after exposure to a CED during law enforcement encounters. Some were normal, healthy adults; many were chemically intoxicated or had heart disease or mental illness. These deaths have given rise to questions from both law enforcement personnel and the public regarding the safety of CEDs. Because many gaps remain in the body of knowledge with respect to the effects of CEDs, the National Institute of Justice (NIJ), the research, development and evaluation agency of the U.S. Department of Justice, conducted a study, Deaths Following Electro-Muscular Disruption, to address whether CEDs can contribute to or be the primary cause of death and, if so, by what mechanisms. The study was directed by a steering group that included NIJ, the College of American Pathologists, the Centers for Disease Control and Prevention, and the National Association of Medical Examiners.

To support the study, the steering group appointed a medical panel composed of forensic pathologist/medical examiners and other relevant physicians or specialists in cardiology, emergency medicine, epidemiology and toxicology. To avoid a conflict of interest, no panelists were chosen who had worked as litigation consultants for or against CED manufacturers. This report contains the findings and recommendations of the medical panel.

In 2008, NIJ released its interim report, *Study of Deaths Following Electro Muscular Disruption: Interim Report*. Among other findings, that report stated, "Although exposure to CED is not risk free, there is no conclusive medical evidence within the state of current research that indicates a high risk of serious injury or death from the direct effects of CED exposure." The interim report described the risks associated with the use of CEDs and provided a set of accepted research findings in its summary. The report also provided recommendations for death investigation, medical response and further research. Although this final report provides additional, significant detail to many of the findings in the interim report, the study panel's interim findings still represent its consensus on the issue of risks associated with CED use.

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This final report provides findings concerning death investigation, CED use, CED-related health effects, and medical response. The panel recommends a thorough review of the entire report and the associated research literature for medicolegal personnel and those making decisions concerning CED deployment and associated policies. The following findings are provided as those of most general interest to date.

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 the direct or indirect cardiovascular or metabolic effects of short-term CED exposure in healthy, normal, nonstressed, nonintoxicated persons. Field experience with CED use indicates that short-term exposure is safe in the vast majority of cases. The risk of death in a CED-related use-of-force incident is less than 0.25 percent, and it is reasonable to conclude that CEDs do not cause or contribute to death in the large majority of those cases.

Law enforcement need not refrain from using CEDs to place uncooperative or combative subjects in custody, provided the devices are used in accordance with accepted national guidelines and appropriate use-of-force policy. The current literature as a whole suggests that deployment of a CED has a margin of safety as great as or greater than most alternatives. Because the physiologic effects of prolonged or repeated CED exposure are not fully understood, law enforcement officers should refrain, when possible, from continuous activations of greater than 15 seconds, as few studies have reported on longer time frames.

All deaths following deployment of a CED should be subject to a complete medicolegal investigation, including a complete autopsy by a forensic pathologist in conjunction with a medically objective investigation that is independent of law enforcement. The complete investigation should include the collection of information specific to CED-related deaths, such as the manner in which and the location where CED darts or prongs were applied. A recommended checklist is contained in chapter 11, "Considerations in Death Investigation," pages 36-37 in this report.

Unlike the risk of secondary injury due to falling or puncture, the risk of human death due directly or primarily to the electrical effects of CED application has not been conclusively demonstrated. However, there are anecdotal cases where no other significant risk factor for death is known. Additionally, current research does not support a substantially increased risk of cardiac arrhythmia in field situations, even if the CED darts strike the front of the chest. There are anecdotal cases where no other significant risk factor for death is known and where the temporal association provides weak circumstantial evidence of causation. The panel reviewed studies on ventricular fibrillation with respect to dart placement, demonstration of ventricular fibrillation, pulseless ventricular tachycardia, pulseless electrical activity in animals, and anecdotal examples of capture in humans wearing cardiac pacemakers or defibrillators. These studies suggest plausible but unproven mechanisms for unusual and rare cases of death due to a confluence of unlikely circumstances.

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In general, the stress of receiving CED discharge(s) should be considered to be of a magnitude that is comparable to the stress of other components of subdual. All aspects of an altercation (including verbal altercation, physical struggle or physical restraint) constitute stress that may heighten the risk of sudden death in individuals who have pre-existing cardiac or other significant disease.

Caution is urged in using multiple or prolonged activations of CED as a means to accomplish subduing the individual. There may be circumstances where repeated or continuous exposure is required; law enforcement personnel should be aware that the associated risks are unknown and that most deaths associated with CED use involve multiple or prolonged discharges.

We offer this report to the police community, the medical community and the public as a contribution to the many considerations necessarily involved in the use of CEDs and other types of force by law enforcement. We offer this report to our colleagues involved in all aspects of medicolegal death investigation to educate them on our findings and to offer possible approaches to their individual case investigations. We know full well that every case is unique and that it is extremely difficult to generalize findings or techniques. We in no way imply that our conclusions or suggestions are the only way to proceed. We offer these for consideration as aids that might be beneficial in formulating a more complete understanding of the circumstances, mechanisms or pathophysiology in determining the cause and manner of death.

It is recommended that law enforcement maintain an ongoing dialogue with medical examiners/coroners and emergency physicians to discuss effects of all use-of-force applications (CED use and other modalities) and evaluate procedures involving life preservation, injury prevention and evidence collection.

Any expert panel brings with it certain limitations. These limitations are due not only to the limitations of our knowledge but also to the perspectives that the panel members bring to the table. This is particularly true with respect to the determination of the cause and manner of death. These differences are not capricious, but derive from varying philosophical viewpoints and traditions regarding how these deaths should be placed within specific cultural and legal contexts. The conclusions in this report represent a strong underlying consensus. In instances when there were disagreements over specific classifications or diagnostic categorizations, the discussions did not reflect differences in the understanding of basic underlying scientific principles but rather the differences inherent in specific jurisdictional-related and historic practices. In fact, there was a strong consensus regarding the principles of these conclusions even in the context of differences in how they might be phrased. In addition, the report is based upon the information available to the panel at this writing. As scientific understanding advances, the opinions of panel members may change to accommodate new findings.

Findings and conclusions of the research reported here are those of the authors and do not reflect the official position and policies of their respective organizations or the U.S.

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Methodology

This study was directed by a steering group with representation from the National Institute of Justice (NIJ), the College of American Pathologists, the Centers for Disease Control and Prevention, and the National Association of Medical Examiners. To support the study, the steering group appointed a medical panel composed of forensic pathologists/medical examiners and other relevant physicians or specialists in cardiology, emergency medicine, epidemiology and toxicology. To avoid a conflict of interest, no panelists were chosen who had worked as litigation consultants for or against conducted energy device (CED) manufacturers. This report contains the findings and recommendations of the medical panel.

In formulating the findings reported here, the panel conducted mortality reviews of CED-related deaths and reviewed the current state of medical research relative to the effects of CEDs. The panel considered nearly 300 CED-related deaths. In these incidents, (a) CED(s) was (were) deployed by (a) law enforcement officer(s) on an individual who later died. In the vast majority of these cases, the original medicolegal investigation concluded that the CED played no role in the death. The panel concentrated its review on those cases in which a CED was listed on the death certificate. NIJ and the International Association of Chiefs of Police worked with several law enforcement agencies to collect information in 22 specific, documented cases involving CED deployment and death. Time and the availability of complete case documentation (from the initial 911 call through forensic autopsy) limited the number of field-based cases reviewed and discussed by the medical panel. However, the cases reviewed were varied and considered representative of all medicolegal cases of death following CED deployment. These reviews were intended to elucidate the relationships between CED use and suspect injury and death and to assist in the development of the material in this final report. The medical panel did not make conclusions that question the findings by any official certifier of death in any specific case. Mortality reviews have included analyses of complete autopsies, findings from the scene investigation, post-exposure symptoms, post-event medical care, and especially the extent, if any, of natural disease or chemical substances in a decedent. The panel reviewed theoretical case scenarios to identify important case-related and interpreted issues regarding the cause, manner and circumstances of death. The panel also examined the currently recognized causes of sudden deaths, chiefly involving physical, cardiac, pulmonary, metabolic and thermoregulatory mechanisms.

Evaluation of mortality following the use of CEDs is often challenging because of several factors: some of the necessary case-specific information can be lacking, human research studies are limited, and the findings in animal studies may not be extrapolated to humans. There are also variations among medical examiners and coroners in the stylistic methods and choices of words used to describe the causes of death and to classify the manner of death. For a broad review such as this one of the safety of CEDs, these considerations can compromise case identification and statistical reviews of mortality following deployment of CEDs.

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This report provides a consensus view of the panel members from a complete review of the available peer-reviewed research literature and extensive information concerning the use of CEDs in the field. The findings have been limited to those conclusions that can be based on current understanding of the available research and literature. A comprehensive literature search was conducted to compile and catalog peer-reviewed research articles that addressed the effects of CED on human subjects. Several resources were used to locate articles, books, news reports, websites, and other literature dealing with the use of CEDs (i.e., stun guns and other nonlethal electrical weapons), including, but not limited to: *Medline*, *PubMed*, *ScienceDirect*, *ProQuestJStor*, *Applied Science and Technology Abstracts* and *Lexis-Nexis*. More than 2,500 sources were identified, of which approximately 175 were selected for this study (i.e., peer-reviewed journal articles, which focused on the physiological effects of CED use). These selected references were divided and distributed to an external panel of forensic pathologists who reviewed and rated each article for scientific quality and relevance. These assessments were used to identify the most important research articles for consideration by the medical panel in this study. In addition, the articles are cited throughout this final report to support specific conclusions. Finally, through the National Association of Medical Examiners, the assessments are available to the medicolegal community for reference in death investigations. The panel urges continued research to improve the medical understanding of CED effects and has made specific recommendations throughout this report in that regard. Due to time constraints, some of the most recent research for this report was reviewed by panel members only.

The panel also consulted stakeholders, experts and other interested parties, such as human rights groups, law enforcement professionals, clinical physicians, research scientists and manufacturers of CEDs. The panel observed more than 30 presentations by these invited experts. It met nine times over three years to discuss these findings and debate their significance to the investigations and certifications of deaths when CEDs are involved. This report represents the panel's best efforts of collaboration and mutual respect for our many divergent points of view and perspectives.

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1. Continued Use of CEDs by Law Enforcement

Conducted energy devices (CEDs) are commonly used by law enforcement agencies. Their use is associated with overall decreases in suspect and officer injuries when deployed with appropriate agency policies.¹ However, exposure to CED is not risk-free. The safety of these weapons has been the subject of controversy. CED deployment has been associated with in-custody sudden deaths. Comprehensive, independent studies have examined the experience of police agencies with respect to the decision to deploy CEDs. These studies indicate that CED deployment by an agency decreases the likelihood of injuries to suspects and officers.¹⁻³ Field experience with CED use indicates that exposure is safe in the vast majority of cases.⁴⁻⁶ One prospective study observed a 0.25 percent risk of serious injury (head trauma or rhabdomyolysis) with CED use, much less than that observed for other subdual options.⁶ Other studies also indicate that CED-related injuries and deaths are uncommon, especially in comparison to other force options.⁷ One review showed that officer and subject injury rates were much lower during CED use compared to use of empty-handed physical skills, incapacitating spray or batons, while another indicated that injury rates were substantially lower with the use of incapacitating sprays and CEDs.^{1,8}

It should be noted that arrestees who are involved in use-of-force incidents are by nature at higher risk for serious complication and death relative to the overall population. These individuals are more likely to be drug-intoxicated, be mentally ill or have serious underlying medical conditions.⁶ There are more than 600 arrest-related deaths in the United States each year and roughly 1 million incidents in which police use or threaten to use force.^{9,10} Nonetheless, the CED is cited as a causative or contributory factor in very few arrest-related deaths each year.⁹ In this context, the relative risk of CED deployments appears to be lower than other use-of-force options.

There is no conclusive medical evidence within the state of current research that indicates a high risk of serious injury or death from the direct or indirect cardiovascular or metabolic effects of short-term CED exposure in healthy, normal, nonstressed, nonintoxicated persons.¹¹ Current medical research in humans and animals suggests that a single exposure of less than 15 seconds from a TASER® X-26™ or similar model CED is not a stress of a magnitude that separates it from the other stress-inducing components of restraint or subdual.¹² Based on cases reviewed by this panel, most adverse reactions and deaths associated with CED deployment appear to be associated with multiple or prolonged discharges of the weapons. There is limited research with regard to exposures of greater than 15 seconds.^{13,14} Further, extended CED exposure may not be effective in the subdual of some individuals with high levels of drug intoxication or mental illness. Therefore, if the CED is ineffective in subduing an individual after a prolonged exposure, law enforcement officers should consider other options.

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Conclusions and Recommendations:

From a purely medical perspective, law enforcement need not refrain from deploying CEDs to place uncooperative or combative subjects in custody, provided the devices are used in accordance with accepted national guidelines and appropriate use-of-force policy.^{15,16} Ideally, use-of-force policy development and post-incident review should be done in consultation with forensic and/or medical experts.

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2. Potential for Moderate, Severe or Secondary Injury

The question often arises whether injuries result from CED exposure, and, if so, to what degree of severity. Answers to these questions are important for several reasons. First, the public and law enforcement agencies need to know the risks of injury in order to have a realistic understanding of risks to persons subjected to CED exposure. This will allow police agencies to develop protocols that minimize the risk of injury and will help the public place CED-related injury in the proper context when CEDs are used by law enforcement personnel. Medical examiners, coroners, other investigators and emergency medical personnel need to understand the types of injuries that can be expected as well as their frequency so they can adequately investigate or treat injuries resulting from CED exposure.

Information to address these questions has been derived from case reports of documented CED-related injuries in humans and from descriptive studies, both prospective and retrospective, of injuries observed in populations following CED exposure.¹⁻¹² Also, some potential injuries have been identified through review of unpublished case reports.

A practical definition of moderate and severe CED-related injury has been published.² Moderate injury requires inpatient treatment and/or is expected to result in no more than a moderate long-term disability. Severe injury involves a threat to life or requires inpatient treatment and is expected to result in severe long-term disability. The potential for moderate or severe injury related to CED exposure is low.^{2, 5, 7, 9, 10, 13-16} Based on published studies, significant injury has been noted in less than 0.5 percent of those experiencing a CED deployment, and has been estimated not to exceed 0.7 percent.¹ However, darts may cause puncture wounds or burns.⁹ Puncture wounds to an eye from a dart could lead to loss of vision.^{4, 6} Pharyngeal (throat) perforation by a dart has also been reported.¹¹ Potentially fatal head injuries or skeletal fractures may result from falls due to muscle incapacitation or intense muscle contraction.^{8, 10} CED strikes to the head have resulted in dart penetration of the skull, and in unconsciousness and seizures requiring medical care.^{3, 10} CEDs can potentially produce other secondary or indirect effects that may result in death. Examples include:

1. Using a CED against a person on a steep slope or on a tall structure, resulting in a fall with traumatic injuries.
2. Ignition risk due to sparks from a CED used near flammable materials such as gasoline, explosives, volatile inhalants such as aerosol sprays, or the flammable propellant used in pepper spray.
3. Using a CED on a person who is in water, resulting in submersion or drowning.

Conclusions and Recommendations:

In summary, the risk of moderate or severe injury or death from a CED exposure, whether the injury is directly due to darts or indirectly due to secondary events (falls, fractures, etc.) is probably less than 1 percent. Evidence from use in the field has shown that the risk of death in a CED-related incident is ≤ 0.25 percent.² These studies do not conclude that all the

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deaths were attributable to CED use. The panel views this as an acceptable level of risk when potential benefits of CED use are considered, such as reductions of serious injuries to suspects and law enforcement officers and the risk associated with other lethal and less-lethal options, when used in accordance with appropriate agency policies.^{17,18} Further study is needed to better characterize the scope and severity of direct and indirect injuries caused by CED use.

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3. Cardiac Rhythm Issues

There is currently no medical evidence that CEDs pose a significant risk for induced cardiac dysrhythmia in humans when deployed reasonably. The heart rhythm issues most important to consider are ventricular fibrillation (VF), ventricular capture (pacing), ventricular tachycardia (VT), atrial fibrillation and pulseless electrical activity (PEA).

Based on research in swine, the risk of CEDs directly causing ventricular fibrillation is exceedingly low.¹⁻⁴ VF is more or less likely depending on the energy vector, i.e., where the darts of the CED are located relative to the heart. Different vectors appear to have lesser or greater chance of producing VF with the greatest risk in swine being sternal notch to heart apex or sternal notch to just above the umbilicus (navel).⁴

There is one case report in the medical literature documenting VF two minutes after the collapse of a teenager who was subdued with a CED.⁵ The proximity of this collapse to CED use and documented VF argues in favor of an electrically induced cardiac event. A recent review of in-custody deaths associated with CED use evaluated individuals who collapsed within 15 minutes of exposure.⁶ Presenting rhythms were available in 56 subjects. In 52 subjects bradycardia-asystole or PEA was seen. The rhythm was VF in four subjects (7 percent). Only one patient collapsed within one minute of exposure, as would typically be expected with VF. Two had a more delayed collapse at five to eight minutes, and one collapsed before exposure. In-custody deaths rarely occur immediately following use of the device, but occur more typically minutes to hours later.⁷ Because a VF-related death would be expected to be almost immediate, VF is unlikely to be the cause in most of these in-custody deaths.

There are telemetry and echocardiographic data in swine to demonstrate rapid ventricular capture (pacing) from CED use with a transcardiac vector (when the darts are located on either side of the heart).⁸⁻¹¹ In some of these animals the ventricular dysrhythmia did not terminate with the end of CED discharge and at times led to the death of the animal. The risk of ventricular capture also appears to be dependent on the vector.¹² There are echocardiographic studies in humans during CED activation, one of which has dart placement in the chest area over the heart that did not show capture.¹³⁻¹⁵ All other echo studies in humans had remote dart placement and did not show capture.¹⁶ In human studies, the CED exposure is typically applied using alligator clips. Subcutaneous dart placement — such as often occurs during a law enforcement use-of-force incident — is rarely used. Because device output through alligator clips is typically lower in energy, human studies may not reflect the full range of cardiac CED exposures. There are recent studies of rhythm analysis just before, during and after CED discharge showing no sustained dysrhythmia.¹⁷⁻¹⁹

Rapid ventricular pacing is a method used by electrophysiologists to induce ventricular tachycardia, and this may potentially lead to ventricular fibrillation minutes later. While VT may be pulseless, patients can sometimes be hemodynamically stable for a period of minutes

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to hours. In other words, a CED may induce rapid ventricular pacing or VT in an individual who appears to be in satisfactory condition, but this may lead to VF after a short delay. Currently, there are no documented cases that CEDs have caused this sequence of events in humans, but it is theoretically possible.

The risks of cardiac arrhythmias or death remain low and make CEDs more favorable than other weapons. Extended CED discharge(s) in swine where rapid ventricular pacing occurred has (have) led to death in some of these animals.²⁰ Therefore, it cannot be concluded that extended discharge in humans is always safe, despite the successful outcomes of extended discharges documented in the literature.

Pacemakers are implantable cardiac devices that maintain heart rhythm when it gets too slow. Defibrillators are implantable cardiac devices that can function as pacemakers, but are designed to detect life-threatening rapid rhythms and shock or stop the abnormal rhythm. There have been anecdotal, though well-documented, examples of cardiac capture by CEDs in subjects with implantable cardiac devices. In no case, however, were these events associated with bad outcomes.²¹⁻²³ There is a case report of an individual with an implanted pacemaker demonstrating ventricular capture during CED use.²¹ It cannot be known if the presence of the pacemaker or its associated wires facilitated capture in the ventricle. In swine studies, capture has occurred in the absence of internal wires. An ultrasonographic study did not replicate this finding in human volunteers,²⁴ and data from field experience does not indicate that complications from capture by CEDs are common.²⁵⁻²⁷

Nonetheless, CED use on individuals with pacemakers and defibrillators can be potentially hazardous. Pacing may be inhibited or asynchronous during CED exposure.²⁸⁻²⁹ There has not been a documented case in which a pacemaker has undergone a power-on reset or triggered an elective replacement indicator (which may be associated with pacemaker malfunction). Additionally, there has not been a documented case in which CED exposure caused a long-term change in pacemaker function, such as lead sensing or pacing threshold. Implantable cardiac defibrillators have been demonstrated to detect CED discharges as potential ventricular fibrillation and have charged but not activated.^{23,28} Limiting the duration of CED discharges will minimize the chance that one of these devices will give an inappropriate shock.

Risk of ventricular dysrhythmias is exceedingly low in the drive-stun mode of CEDs because the density of the current in the tissue is much lower in this mode. However, there is a case report in the literature where a patient documented to be in atrial fibrillation became combative and was subdued with one drive stun delivered directly over the heart. He was immediately documented to be in a sinus rhythm thereafter.³⁰ An individual's heart rhythm can spontaneously convert from atrial fibrillation to sinus (normal) rhythm. Nonetheless, the conversion from atrial fibrillation to a sinus rhythm in this case would appear to be temporally attributable to the CED.

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In approximately one-quarter of CED deployments in the field the darts strike the anterior chest.³¹ With dart deployment the most likely vector to produce cardiac effect would be near the heart and in line with the long axis of the heart.^{12,31} Deployments to other regions of the body are very unlikely to generate enough current in the region of the heart to cause ventricular capture or fibrillation. Additionally, when subjects are exposed to CED deployment in the field they often fall and may land in a prone position, driving darts further into the chest wall. This decrease in dart-to-heart distance may increase the likelihood of direct cardiac effects. Individuals of smaller stature may have a shallower distance between the skin and the heart, so they may be more susceptible to cardiac effects associated with dart placement near the heart. This possibility is of theoretical concern and has not been demonstrated.

There is a multitude of ECG and cardiac enzyme data in the literature supporting no significant long-term effects on the heart by CED use. Autopsies have not demonstrated evidence of myocardial infarction (heart attack). The available data do not show long-term blood chemistry changes affecting cardiac function. There are some recent data demonstrating significant increase in blood acidity (acidosis) in animal models after CED use.²¹ Some research has examined the role of exertion in combination with CED effects. Extreme physical exertion causes an increase in acidosis because of the production of lactate in the muscles. Severe acidosis can cause spontaneous dysrhythmias that would not be a direct effect of CED use.³² Additionally, severe acidosis can lead to pulseless electrical activity which may be a mechanism of sudden death seen after a prolonged struggle. CED exposure does not appear to worsen the acidosis that is present from exertion alone.³³⁻³⁵ Metabolic effects of CED exposure are detailed elsewhere in this report.

There is a controversial case report of the successful resuscitation of a teenager with bipolar disorder and polysubstance abuse who was subdued with a CED. He was reportedly found not to be moving approximately 20 minutes after CED exposure. Emergency medical services personnel found him to be in asystole shortly thereafter. The individual was resuscitated and eventually discharged from the hospital with no apparent long-term deficits.³⁶ In one publication, bradycardia-asystole or PEA was seen in 93 percent of sudden deaths which quickly followed discharge of CEDs⁶. Either of these dysrhythmias can be precipitated by severe acidosis or could be the terminal rhythm following another life-threatening rhythm. It remains unclear if CED use contributes to the development of PEA or asystole. Rapid recognition of a possibly reversible dysrhythmia in cases like this is imperative to allow for attempted resuscitation.

Although sudden death occurs in custody with and without the use of CED, the exact mechanism of death in many cases is often not clear.^{7,37,38} Sometimes, individuals who have been restrained or are in the process of being subdued will stop moving or responding. In many cases, the individual may simply be passively compliant. In some cases, the individual may be experiencing a medical emergency related to acidosis, respiratory compromise, or

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cardiac arrhythmia. Therefore, the restrained individual should be constantly monitored for responsiveness and general medical condition.

Conclusions and Recommendations:

Law enforcement personnel are trained to target center body mass when using CEDs. TASER® International, Inc., (a major CED manufacturer) has recently recommended a change in target zone to below the chest. TASER® Bulletin 15 states, “By simply lowering the preferred target zone by a few inches to lower center mass, the goal of achieving Neuro Muscular Incapacitation (NMI) can be achieved more effectively while also improving risk management.”³⁹ The panel does recognize that CED use involving the area of the chest in front of the heart area is not totally risk-free; current research does not support a substantially increased risk of cardiac dysrhythmia in field situations from anterior chest CED dart penetrations.

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4. Respiratory and Metabolic Issues

The balance of acid and base in the body is maintained by the respiratory system and the kidneys. These respond to the metabolic demands of the individual. As with rigorous exercise, the CED causes muscle contractions that produce lactate in the blood. Lactate lowers the pH of blood, making it more acidic. Respiratory rates increase to counteract this effect by reducing the amount of carbon dioxide (CO₂) in the blood and thereby mitigating the effects of the increased lactate. In extreme cases, the increase in blood acidity (referred to as "acidosis") could lead to cardiac arrest. Studies of CED effects have examined respiration, blood chemistry and the effects on muscle groups. In particular, observation of persons subjected to CED exposure seems to indicate that muscle groups are affected that fall outside those in the area directly between the darts. For example, CED discharges to the thorax often result in collapse to the ground, suggesting that there may be a spinal cord reflex involved that can affect muscle groups under the control of lower spinal cord levels. If that is the case, it seems reasonable that intercostal (between the ribs) muscles used for respiration could also be impacted, with an adverse effect on ability to breathe during CED exposure.

Research to date, however, shows that human subjects seem to maintain the ability to breathe during exposure to a CED. In fact most evidence suggests hyperventilation with an increase in respiratory rate, tidal volume, and minute ventilation during CED exposure. Direct observation of diaphragmatic movement was seen in one study.¹ Despite the hyperventilation, which typically produces an increase in blood pH, a mild decrease in pH indicating metabolic acidosis is often seen with more prolonged exposures. In conjunction with this is an increase in lactate consistent with metabolic acidosis. Alcohol consumption appears to contribute only minimally to an additional decrease in pH or increase in lactate levels.²

Very little research has been done on the role of CED vectors (i.e., the positioning of the CED darts) and the effect on respiration. Some studies have examined variable vectors, but with a focus on cardiac effects. As noted below, it is difficult to examine respiratory effects in animal studies.

A recent study of 104 volunteers reports that 18 percent of subjects with CED exposure to the back perceived an inability to breathe during CED exposure, but such inability to breathe was not documented by direct observation or physiologic tests of breathing capacity. The researchers concluded that the results pointed mainly to a need for further study. The medical panel reviewed an unpublished follow-up study using sensors to monitor breathing directly. That study appears to indicate that CEDs could interfere with the ability to inhale, depending on dart placement. Breathing is controlled by the phrenic nerve, which originates in the cervical spinal cord and innervates the diaphragm, in conjunction with intercostal nerves, which originate in the thoracic spinal cord and innervate the intercostal muscles. Therefore, if CED exposure interferes with breathing, it may not be an all-or-none

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phenomenon. For example, the intercostal muscles may be affected while the diaphragm is not, or vice versa. Further study with objective measurement of breathing is needed to draw more definitive conclusions. Such studies should involve both short term CED exposures and more prolonged or repeated exposures. Hypoventilation could contribute a respiratory component to any underlying acidosis. With prolonged exposure, if CO₂ levels rose significantly, respirations could be further suppressed from the high CO₂ levels despite termination of CED exposure.

Studies with swine have been conducted using an extended exposure of 80 seconds, producing significant acidemia as well as hypoventilation. A few of these animals have died. The animal literature is complicated by the use of sedation that may play a role in hypoventilation and a failure of respiratory compensation for a metabolic acidosis. In other words, the animals' breathing may be compromised by some combination of sedation, CED exposure and other confounding factors from the experimental design. Animal studies suggest that the metabolic acidosis is secondary to an increase in lactate produced after strenuous muscle contraction. In one study, animals were paralyzed to prevent muscle contraction during CED exposure. In this case, acidosis was much less severe but significant cardiac effects were still observed.³

There are recent data in the literature of human studies looking at the effect of exercise and CED exposure and their individual contributions to blood acidosis. CED exposure does not appear to add to acidosis above and beyond that seen with exercise to exhaustion. CED exposure without exertion produces only a mild acidosis.⁴⁻⁶

Conclusions and Recommendations:

Significant acidosis can lead to pulseless electrical activity and may be a mechanism of sudden death in custody. Of particular concern is the possible role that systemic acidosis may play in addition to any metabolic abnormalities or drug intoxication seen in excited delirium, as discussed elsewhere in this report. Further study is required in this area. Until the role of CEDs with respect to respiration has been researched fully, it would be appropriate for law enforcement personnel, when possible, to refrain from continuous activations of longer than 15 seconds. In any case, it is recommended that the medical condition of the individual be constantly monitored during and after CED exposure, regardless of the duration of exposure.

In addition to the concerns related to the effect of CED exposure on respiration, there is a case report in the literature of pharyngeal (throat) perforation from CED discharge.⁷ This patient presented with spitting of blood and difficulty breathing.

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5. CEDs as Contributors to Stress

“Stress,” as used in this discussion, describes the body’s reaction to threat or physical insult, including but not limited to the adrenaline-related (adrenergic or catecholamine) “flight or fight” reaction. The literature on the acute and chronic effects of stress is large and will not be reviewed extensively here.

Whenever law enforcement officers subdue or restrain an individual, they are contributing to the person’s stress level. All aspects of an altercation (including verbal altercation, flight, physical struggle, or physical restraint) constitute stress that may heighten the risk of sudden death, generally from a cardiac dysrhythmia. Whether or not a CED deployment is involved and regardless of the intent of the officer, it is possible for the actions of an officer to directly or indirectly contribute to death by inducing stress. Stress induced by the criminal action of others may be considered a contributing factor in initiating the mechanism of death in certain individuals with underlying natural disease. For example, if an individual with a heart condition dies as a result of being the victim of a robbery, the death may be ruled a homicide caused by the stress of the crime¹⁻³. In a similar fashion, stress may be an important issue to consider when investigating and certifying deaths following CED use or when other forms of restraint or subdual are used. One proposed mechanism by which CED use may contribute to death is by increasing stress, which can potentiate the adrenergic responses of tachycardia (i.e., rapid heart rate) and elevated blood pressure, making it an issue related to cause and manner of death determination. There may also be additional physiologic or metabolic effects, especially when stress is severe or other factors have already put the individual into a compromised medical condition, as may occur in individuals who have pre-existing cardiac or other significant disease or who are intoxicated. An important question is whether or not stress caused by CED exposure is different enough from other forms of stress during the agitation, restraint or subdual to justify its separate consideration when certifying death.

The data used to address the stress issue have been derived largely from prospective studies conducted on human volunteers. Medical research suggests that a single exposure of less than 15 seconds deployed from a TASER® model X26™ or a similar model CED is not a stress of a magnitude which separates it from the other stress-inducing components of restraint or subdual.⁴ There were no cardiac dysrhythmias among healthy volunteers exposed to one discharge of a TASER® model X26™ for less than 15 seconds following either anaerobic exercise, rigorous exercise or exercise to exhaustion.⁴⁻⁶ A study using drive-stun mode on volunteers also failed to show cardiac rhythm disturbances or diaphragm disturbances.⁷ However, because the numbers of subjects in these studies were small, the subjects were healthy, and the risk of ventricular fibrillation due to a single CED discharge is very low, the applicability of these studies to field conditions is questionable.

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It has been proposed that acute stress can damage the heart muscle. There are several reports that suggest that acute stress (with catecholamine release) may cause a cardiomyopathy (or disease of the heart muscle) and be induced in certain individuals during police confrontation. There are insufficient data to provide diagnostic criteria for such a syndrome, although some research and case reports exist.⁸⁻¹¹ Japanese cardiologists initially described “acute stress cardiomyopathy” with transient left ventricular apical ballooning and normal coronary vessels in otherwise healthy, asymptomatic individuals who died in police custody.⁸ Such deaths occurred in the absence of CED exposure and are believed to involve a sudden cardiac dysrhythmia induced by a surge in adrenaline. Other studies of CED exposure have examined parameters such as blood chemistry, cardiac enzymes and blood gases.^{5,12,13} Although studies on human volunteers undergoing prolonged (greater than 15 second) CED exposure showed statistically significant changes in blood gases, these changes (or any respiratory impairment) appear to have limited clinical significance in these healthy individuals.^{13,16}

Further study is needed to determine the quantity of stress caused by prolonged or repetitive CED exposure in normal subjects, and larger numbers of human subjects need to be tested. Similar studies in persons with significant disease or drug intoxication would provide more useful data. However, it is not ethical to conduct human studies which attempt to replicate certain “field conditions” (such as drug intoxication with agitation) encountered in CED-associated, police confrontation deaths. The fatal mechanisms of stress and catecholamine release need further clarification, and methods to measure and quantify stress effects should be investigated. Until such methods are developed or more comprehensive field data are obtained, it is reasonable to infer that the effects of acute stress can be cumulative, and that the cumulative effects of adrenaline and other factors such as acidosis may increase an individual’s risk of experiencing a sudden cardiac dysrhythmia.

Conclusions and Recommendations:

Current data on stress induced by CED exposure are limited because the number of persons studied (sample size) is small and the subjects typically have been healthy volunteers. Further, interpretations are hampered because reliable markers for catecholamine-related stress and its complications are not well identified or accepted. Cases of death may exist where the CED deployment may be the only or predominant inducer of stress. Special attention to such cases is warranted when considering potential mechanisms of death.

CED exposure may contribute to “stress,” and stress may be an issue related to cause-of-death determination. All aspects of an altercation (including verbal altercation, physical struggle or physical restraint) constitute stress that may heighten the risk of sudden death in individuals who are intoxicated or who have pre-existing cardiac or other significant disease. Medical research suggests that CED deployment during restraint or subdual is not a contributor to stress of a magnitude that separates it from the other stress-inducing components of restraint or subdual.¹⁵

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6. Excited Delirium

Excited delirium (ExD) 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.¹⁻³ ExD-associated agitated behavior often leads to law enforcement intervention and CED use. The predominant theory of the underlying etiology of ExD is an excess of catecholamines (such as adrenaline) or sympathetic nerve stimulation during the excited period. However, a syndrome, by definition, is a collection of signs and symptoms, not a specific disease. People with multiple conditions may present in this manner, including drug-induced psychosis, serotonin syndrome, diabetic ketoacidosis, paranoid schizophrenia and others. Alcohol withdrawal and head trauma have also been implicated.⁴ Recent research suggests that individuals with a history of chronic illicit stimulant abuse may be particularly susceptible to excited delirium.⁵

There has been criticism of the term “excited delirium” because its use is generally limited to medical examiners and emergency medicine physicians whose patients die before a complete workup is completed that would allow for a more specific diagnosis. Whether one uses the term or not, ExD-related behavior and medical conditions are well-recognized.

In general, excited delirium may have a mortality of about 10 percent.⁶ Sympathomimetic agents include substances such as cocaine, methamphetamine, epinephrine (adrenalin), and dopamine. There is a subset of ExD-affected people who have sympathomimetic poisoning with malignant hyperthermia (high body temperature), sometimes associated with elevated serotonin levels. These cases have a grim prognosis and are at high risk of death regardless of police actions or method of subdual. In one study of 12 patients who made it to the hospital, four died and five suffered severe neurologic complications. This correlates well with other published observations that mortality is about 67 percent for those with a temperature above 41.5 degrees Celsius (106.7 degrees Fahrenheit).^{6,7} ExD is frequently but not always associated with the use of cocaine and other stimulants.⁸ One study reported that 78 percent of excited delirium cases had serological evidence of stimulant intoxication.⁹

There are other forms of combative, agitated behavior that require subdual; often grouped together under the umbrella of emotionally disturbed persons (EDPs). EDPs may be mistaken for people with excited delirium, and a subset of these may in fact display features of ExD. However, not all EDPs that require subdual have the syndrome of ExD.

There is ongoing research in how best to manage patients with ExD. However, it is clear that at least some of these patients are medically unstable and in a rapidly declining state with a risk of mortality in the short term. This holds true even with medical intervention or in the absence of CED deployment or other types of subdual. While studies in young, healthy,

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drug-free volunteers suggest that CED deployment has inconsequential metabolic and stress-related effects, no human studies have been performed in situations modeling ExD.¹⁰

Because of this uncertainty, the number and duration of the CED discharge(s) should be generally limited to the minimal amount needed to attain restraint. Police officers should be aware of ExD-related behavior and indications, especially hyperthermia, which is easy to recognize and associated with the worst outcomes.

Conclusions and Recommendations:

The “drive-stun” or contact mode of CED use is a pain compliance procedure, and does not cause muscular incapacitation enabling restraint. Some sources indicate that people suffering from excited delirium are relatively insensitive to pain as a result of their condition. Some reports from law enforcement reinforce this view, because there are individuals who do not appear to be affected by the pain associated with CED exposure. Thus, “drive-stun” mode and other pain compliance methods should not be repeated in these individuals if they are found to have little or no initial effect.

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7. Safety Margins of CEDs

Most fatalities involving CED use are in people who have other risk factors for sudden death. This is a concern for law enforcement, because a large number of arrestees will have unrecognized clinical states of drug intoxication or pre-existing medical conditions that put them at risk for sudden, unexpected death, regardless of the type of subdual or restraint used. The medicolegal death investigator must identify the currently recognized safety margins of CED deployment in order to evaluate competing possible causes of death. Most of the deaths reviewed by the panel for this report involved individuals with drug intoxications or complicating medical conditions or both, thus making judgments about the relative role of CED exposure in the deaths very difficult.

It is clear that physical injury secondary to dart puncture, fall and other physical effects is a real though relatively uncommon danger. These are discussed at length elsewhere in the report, as is the literature regarding the cardiac, respiratory and metabolic effects of CED use. The latter suggest small risks associated with CED use, especially for healthy individuals.

However, there are groups who may be at risk for sudden death and those who are more vulnerable to physical insult. These disparate but occasionally overlapping groups include small children, those with diseased hearts, the elderly and pregnant women. For instance, the death of a seven-month-old infant following the application of a stun gun by his foster mother has been reported.¹ The small size of this infant, coupled with the nearness of the contact electrodes to the heart, was postulated as a plausible mechanism for death. Case reports of fetal death due to exposure to electrical current exist, all involving exposure significantly more severe than that associated with CED exposure.² In contrast, one study of 31 pregnant women subjected to electric shock, not from CED deployment, but including 12 V (telephone line), 110 to 220 V (home appliance), and 2000 and 8000 V (electric fence) current, found no adverse effects to the pregnancies.³ There has been no research or field study demonstrating a significantly higher or lower risk for CED use with any particular group.^{4,7}

Unlike the risk of secondary injury due to falling or puncture, the risk of human death due directly or primarily to the electrical effects of CED application has not been conclusively demonstrated. However, there are anecdotal cases where no other significant risk factor for death is known and where the temporal association provides circumstantial evidence of causation, albeit weak.⁸ The panel recognizes the distinction between correlation and causation and that close temporal relationships do not necessarily prove causation. Studies on ventricular fibrillation with respect to dart placement, demonstration of ventricular fibrillation, pulseless ventricular tachycardia, or pulseless electrical activity in animals, and anecdotal examples of ventricular capture in humans with cardiac pacemakers or defibrillators provide a plausible mechanism for unusual and rare cases of death due to a confluence of unlikely circumstances. Multiple plausible mechanisms have been proposed but none proven.⁹

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Many subjects of CED exposure are under the influence of drugs. One study suggested that cocaine intoxication decreased the risk of arrhythmia in animals, though it was limited by the lack of controls and the complex manipulation of the animals required by the study.¹⁰ Similarly, a study on prolonged exposure in alcohol-intoxicated adult humans revealed no significant morbidity.¹¹ Thus, there is currently no basis in scientific research to conclude that drug use increases or decreases the safety margin of CED exposure.¹¹

The safety margin of CEDs is subject to the variability in the output of the devices. Researchers are continuing to study the most common CEDs in use today, the models X26™ and M26™ from TASER® International, Inc., to determine the variability of their output. The effect of this output variability on cardiac safety margin is unclear.

Most research has been done using devices from TASER® International, Inc. Medical and safety data regarding stun batons, CED projectiles and other devices are much more limited. Although the early data suggest similar results, the current literature is sparse.¹²⁻¹⁶ Another manufacturer, Stinger Systems, Inc., manufactures CEDs that are being used in some agencies and that are purported to have an improved safety margin because they declare to operate at lower power levels than the TASER® models X26™ or M26™. Independent research on Stinger Systems devices is very limited, so the panel could not judge the relative safety margin of these devices.¹⁷

Conclusions and Recommendations:

The literature suggests a substantial safety margin with respect to the use of CEDs when they are used according to manufacturer's instructions. However, plausible mechanisms of injury do exist which make it impossible to exclude direct lethality in every case. The safety margins of CED use in normal healthy adults may not be applicable in small children, those with diseased hearts, the elderly, pregnant women and other potentially at-risk individuals. The effects of CED exposure in these populations are not clearly understood, and more data are needed. The use of a CED on these individuals when recognized during attempted subdual should be minimized or avoided unless the situation excludes other reasonable options.

The use of manual techniques, baton blows, CEDs, other less-lethal technologies and even taking no action at all will each carry its own risks. All evidence suggests that the use of CEDs 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. The decision to use a CED or other options is best left to the reasonable tactical judgment of trained law enforcement at the scene.

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8. Prolonged Exposure

There is no evidence in animals that indicates a high risk of injury from a single discharge lasting less than 15 seconds from a TASER® X26™. Unlike the TASER® X26™, which requires the user to hold the trigger to maintain discharges longer than five seconds, other CEDs will apply a longer discharge without any intervention from the user. The TASER® C2™, designed for civilian use, applies a 30-second exposure to a target. Thirty-second exposure to the output of the TASER® C2™ CED in swine resulted in significant changes in blood chemistry, although most of the blood changes returned to baseline after the CED discharge ended. This raises concern for potential detrimental effects due to use of the TASER C2™ CED.¹ However, in one study, 20- to 30-second C2™ CED application in healthy humans had no significant deleterious effects on their physiology.²

The most common version of the dart-mode CED is the X26™ manufactured and sold by TASER® for law enforcement. When the trigger is pulled and the darts attach to the skin or clothing, the device delivers its standard charge as an initial pulse wave of up to 50 kV, followed by a series of low-current (2.1 milliamps, 70 mJ) pulses for five seconds. The device has the ability, however, to deliver extensively prolonged and uninterrupted discharges. The standard discharge cycle may be shortened or prolonged by either maintaining pressure on the trigger *continuously* over variable periods of time or by *repeatedly* depressing and releasing the trigger over variable intervals limited only by the power in the battery (approximately five minutes).

There is no standard definition of “prolonged” CED exposure for either continuous duration or number of multiple interrupted discharges. The majority (93 percent) of CED exposures in the field involve 15 seconds or less; a significant body of the medical literature has employed 15 seconds or less of CED exposure.³

After a review of anecdotes that seemed to indicate that multiple exposures were more hazardous, one researcher recommended in 2005 — without supporting documentation — that law enforcement agents should “... [l]imit the number of TASER® exposures when possible (3 is probably a reasonable number).”⁴ The Police Executive Research Forum produced guidelines for police concerning CED use including a recommendation that “[w]hen activating a CED, law enforcement officers should use it for one standard cycle and stop to evaluate the situation (a standard cycle is five seconds). If subsequent cycles are necessary, agency policy should restrict the number and duration of those cycles to the minimum activations necessary to place the subject in custody.”⁵ The Canadian Police Research Centre recommended: “... continuous cycling of the TASER for periods exceeding 15-20 seconds may increase the risk ... and should be avoided where practical.”⁶

Recommendations by the principal manufacturer, TASER® International Inc., have changed over time. Prior to 2008, they warned against extended duration applications [greater than 5 seconds], noting in particular that darts over the chest or diaphragm may impair respiration

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and cautioned that "... [u]sers should avoid prolonged, extended, uninterrupted discharges or extensive multiple discharges whenever practicable..."⁷ Their 2008 training bulletin (#14) concludes that more recent tests on humans demonstrate that "... there are no adverse effects on heart function or respiration deriving from multiple or prolonged deployments."⁸

Studies examining the effects of extended exposure in humans to CEDs are limited to humans exposed to less than 45 seconds. The majority of studies are limited to exposures of 15 seconds or less. Review of deaths following CED exposure indicates that some are associated with prolonged or multiple discharges of the CED. By contrast, experiments using healthy human volunteers have found no cardiac dysrhythmias^{9,10} or respiratory dysfunction¹¹ following exposures less than 45 seconds. There are no published studies of humans exposed in excess of 45 seconds. Continuous 15 second application of the X26™ to either the back or chest of "physically exhausted" adult humans (designed to mimic field situations), over a 12-inch anatomic spread encompassing the heart, yielded normal electrocardiograms.¹³

Bozeman et al. reported in 2008 that among 1,201 cases in which a CED was used, 18.5 percent received CED discharges three or more times.¹³ In one of these 222 incidents, an individual sustained significant injury, although it is unclear whether the CED played a role in the injury. The repeated or continuous exposure of a CED to an actively resisting individual may not achieve compliance, especially when the individual may be under drug intoxication or in a state of excited delirium.

The medical risks of repeated or continuous CED exposure beyond the durations studied in humans are currently unknown, and the role of CEDs in causing death is unclear in these cases. Uncertain risks associated with the effect of CEDs on respiration should be noted, as detailed elsewhere in this report (see chapter 4). These risks reinforce the view that prolonged, continuous CED exposure should be avoided, if possible.

Despite the well recognized limitations implicit in the applicability of results of animal experiments to humans, the evidence from experiments with swine models indicates that repeated exposures of over 80 to 90 seconds total duration have been associated with increased risk of ventricular fibrillation and mortality.¹⁴⁻¹⁶ Swine studies involving exposure durations of 15 seconds or less are not associated with increased risks for ventricular fibrillation.¹⁷ Intermittent exposures appear to be tolerated better than continuous exposure.¹⁵⁻¹⁹

Conclusions and Recommendations:

There may be circumstances in the field that require repeated or continuous exposure to a CED discharge. Law enforcement personnel should be aware that the associated risks are unknown and that most deaths associated with CED use involved multiple or prolonged discharges. Therefore, multiple or prolonged activations of CED as a means to accomplish subdual should be minimized or avoided.

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9. Research Associated With the Decision to Use a CED

Law enforcement agencies have deployed CEDs under a variety of circumstances and with a range of agency policies. The determination of appropriate use-of-force in police action has an extensive literature that goes well beyond the scope of this panel. There are currently efforts at a national level to establish guidelines for use within this context.¹⁻³ Individual departments revise their policies on a continuing basis. In one study of more than 500 agencies, 14.9 percent of agencies surveyed indicated that they were considering changing their use-of-force policies, and 21 percent already had.⁴ Some agency policies allow the use of a CED only as an alternative to deadly force. In many cases, policies permit the use of CEDs in a wider variety of incidents, including passive resistance scenarios.⁵ Among other considerations, agencies must consider the safety aspects of CED deployment when making these policy decisions. In addition, medical examiners are commonly called upon to offer an opinion about the level of force that was applied in a custody-related death. The recognition of appropriate versus inappropriate use of force can have significant medicolegal consequences.

It was not the mandate of this panel to develop use-of-force policies for law enforcement agencies or to review CED-related deaths with respect to whether police acted appropriately in any specific instance or whether specific policies or force options are advisable. Nonetheless, it is clear that the relative risk associated with CED deployment must be viewed in relationship to the risks of other alternatives, and not viewed in a vacuum. Multiple departmental reviews have suggested that injury rates, death rates and complaints against police drop significantly following the deployment of CEDs. For instance, deployment of CEDs in Charlotte, N.C., was associated with a 56.4 percent reduction in officer injury and a 79 percent reduction in suspect injury.⁶ An independent study has indicated an increase in in-custody deaths following the adoption of CEDs, based on survey data, but the role of CEDs in any of these deaths was not examined.⁷ These results are not normalized for crime rates or other factors.

Independent studies of use-of-force outcomes involving CEDs have been completed, and they substantiate the view that CED deployment, in general, decreases the likelihood of injuries to suspects and officers.^{5,8-10} Further, national statistical data indicates that, despite widespread use of CEDs in law enforcement, CED deployment is associated with only a small proportion of in-custody deaths.¹¹ In the largest independent study to date, involving 12 agencies and more than 24,000 use-of-force cases, the odds of suspect injury decreased by almost 60 percent when a CED was used.^{8,9} Officer injuries were either unaffected or reduced when a CED was used. In contrast, using physical force increased the odds of injury to officers by more than 300 percent and to suspects by more than 50 percent.^{8,9} In general, the outcome data are consistent with medical research and this panel's review of deaths following CED deployment. Deployment of CED has a margin of safety as great as or greater than most alternatives.¹²⁻¹⁴

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Conclusions and Recommendations:

In general, CEDs are safe when used properly. Nonetheless, care should be taken when CEDs are deployed. Researchers have recommended that passive resisters should not be subjected to CED use and that CED discharges should be limited to the number needed to gain control of the suspect.⁸⁻¹⁰ It has been suggested that CEDs should not be used unless the only other alternative is lethal force. However, if a goal is minimization of harm, it is appropriate to use the force application that is associated with the least likelihood of injury. CED use is associated with a significantly lower risk of injury than physical force, so it should be considered as an alternative in situations that would otherwise result in the application of physical force. Police officers need to be aware that, although CEDs provide an effective alternative to lethal force, it is still possible to misuse the device if it is deployed outside the bounds of departmental policies derived from national guidelines. Use-of-force policies are a function of training, cultural context, operational contingencies and scientific concerns. Beyond the recognition of the lower injury rates to officers and suspects associated with CED use, it was not the mandate of this panel to make recommendations for a national use-of-force model or precisely where CED use should be placed within it.

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10. Post-Event Medical Care

Individuals who have received CED discharges may suffer injuries during the incident and also may have pre-existing medical conditions or traumatic injuries, which should be assessed by medical personnel. Appropriate medical care should be provided if these are present or suspected, especially when falls, burns or other trauma occur, or when darts penetrate obviously sensitive areas of the body.

Medical screening. Some form of medical screening is recommended after all CED exposures starting at the scene of the incident. This may take the form of jail intake medical screening, evaluation by emergency medical service (EMS) providers in the field, or by hospital emergency department personnel.

Dart removal. In most cases, darts embedded in the skin may be removed at the scene by properly trained medical or law enforcement personnel in accordance with local protocols. When removing embedded darts, care should be taken to avoid exposure to bloodborne pathogens. Individuals handling darts should be mindful of sharp points and additional spines located around the components of the newer CED device projectiles. Medical care should be provided when darts are located in potentially vulnerable areas such as the face, eyes, neck, genitals or groin, or if there is concern for underlying injuries, regardless of body location.¹⁻⁴

Monitoring in-custody. Ongoing monitoring of suspects while in custody is strongly recommended. Changes in physical condition or mental status/behavior may occur due to effects of drugs (which may have been ingested or undergone continued absorption), medical conditions, or as a result of head trauma or internal injuries. These subjects should be immediately referred for medical evaluation and appropriate therapy delivered by qualified specialists.

Outpatient follow-up. In the absence of injuries, no specific medical follow-up is required after most CED exposures. However, suspects who have an implanted cardiac device (pacemaker or implanted defibrillator) should be evaluated by a physician and have the device and its stored data analyzed.⁵ In cases with ocular injuries or CED discharge near the eyes, outpatient ophthalmologic follow-up is recommended to exclude complications such as retinal detachment or delayed cataract formation.^{2,6} Those reporting or suspected of having significant medical or psychiatric conditions following CED use should also be evaluated to determine if they may be CED-related and to provide appropriate care. Although neuropsychologic dysfunction and complaints (physical, cognitive and emotional) have been well-documented with non-CED electrical injury, it is not clear at this time if this may also occur after CED exposure.⁷

Continued abnormal behavior. A minority of suspects taken into police custody (with or without CED use) will exhibit continued or ongoing abnormal behavior. Abnormal mental status and/or increased body temperature in combative or resistive subjects may be

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associated with an increased risk for sudden cardiac arrest and death. Underlying medical or drug-induced conditions (such as hypersympathomimetic states, hyperthermia, acidosis, excited delirium, rhabdomyolysis and others) may be responsible for extensive struggling and other behaviors that require subdual by law enforcement, including the use of CEDs. There could also be underlying changes in body chemistry, hypoxia and/or acidosis due to suspect behavior and activities prior to subdual and CED use.⁸ Precautions should be taken during any form of restraint to allow for reasonable chest movement and airway protection.⁹

Abnormal agitation and confusion should be treated by law enforcement personnel as a medical emergency. EMS should be immediately dispatched to the scene when this is recognized (law enforcement should not wait until a subject is subdued and in custody; EMS should be called immediately). Further, it must be recognized that a nonmoving or unresponsive subject may be in a medical crisis (i.e., cardiac arrest) rather than being intentionally passive.

Emergency medical treatment. In such cases, emergency medical providers should initiate medical support as soon as it is safe to do so. If warranted, sedation, hydration and cooling should be provided as soon as possible in addition to standard assessment, resuscitation and supportive care. Emergency medical services protocols specifying these interventions in the field may be useful and are already in place in some systems.¹⁰

Medical personnel both in the field and in the hospital setting are encouraged to assess and document vital signs including body temperature and oxygen saturation levels, cardiac rhythm,^{9,11} neurologic status, and physical findings. Spinal precautions and diagnostic evaluations for traumatic injuries may be appropriate based on the history and physical findings. Blood and urine samples should be obtained early for laboratory studies, which may include serum glucose, electrolytes, pH, lactate levels, cardiac enzymes, urine toxicology screen and urine myoglobin, among others.^{12,13}

Forensic aspects of medical care, Some agencies obtain photographs of imbedded CED darts in the field prior to removal. In cases of critical illness, injuries or death, all darts and clothing removed during medical care (after photography prior to removal if feasible) should be retained for investigative purposes by the medical examiner/coroner/law enforcement agency and handled as evidence. Detailed records of medical treatment should be maintained in all cases.

Conclusions and Recommendations:

Medical personnel should provide appropriate care to individuals who have received CED discharges as these individuals may suffer injuries during the incident and may also have pre-existing medical conditions needing assessment. Medical screening at the scene of the incident, the proper removal of dart(s), and the ongoing monitoring of individuals in custody for abnormal physical and behavior changes are crucial procedures. Suspects with implanted cardiac devices should receive outpatient follow-up as necessary. Detailed records,

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including photographs of the scene and body, should be obtained in all cases; these records should include documentation of medical treatment provided.

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11. Considerations in Death Investigation

If a death occurs following the use of a CED by law enforcement personnel who are subduing, restraining, or apprehending a subject, the death will be investigated by the appropriate medical examiner or coroner's office as an in-custody death. Because deaths following CED deployment involve both complex and predictable issues, the death investigation needs to include consideration of information that may not be gathered in a routine death investigation or other in-custody death investigations. It is not the intent of this report to provide a comprehensive checklist of tasks which should be performed. Rather, we are providing what we believe will be helpful suggestions for consideration in the most important aspects of CED-related death investigations.

The information needed for investigation of death following CED use will need to be collected by death investigators from multiple sources and at the direction of the medical examiner or coroner who has ultimate responsibility for determining the cause and manner of death in the case. Further, the forensic pathologist who performs the autopsy will need to review such information, perhaps request additional information, and will develop information from the autopsy examination which may trigger or require additional investigation. The forensic pathologist who performs the autopsy is an integral part of the investigative team.

The following information can be useful in establishing facts and should be considered during the death investigation:

1. A timeline of all events with attempts to verify, to the extent possible, the accuracy of the dates and times of reported events, with specific emphasis on the interval between CED use, unresponsiveness and death.
2. Clarification of CED model and mode of use (drive-stun and/or cartridge mode).
3. Access to a comparable CED for familiarization with design and functionality;
4. Recent activities of the subject prior to the incident.
5. The emotional state of the subject.
6. The subject's reaction to each deployment.
7. The subject's medical conditions as determined by medical history, medical record review and medical conditions determined at autopsy.
8. The subject's drug use history, including prescription and illicit drugs as well as alcohol.
9. Specific inquiry into the subject's cardiac history, including review of any electrocardiograms or other cardiac function or laboratory tests which have been performed in the past.
10. Specific inquiry into the subject's seizure history to rule out history of seizures or to clarify the nature of a past seizure disorder.
11. Review of witness accounts, police reports, use-of-force reports, emergency medical services records, medical and psychiatric records, and any videos, photographs or

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digital images of the events.

12. Determination whether body temperature and ambient temperature were established and documentation of dates and times of such recordings.
13. If death occurred after arrival at a hospital, obtaining blood drawn upon arrival at the hospital so it may be tested for intoxicants, including medications, if needed.
14. Review of downloaded information from the CED with special attention to an assessment of the number, duration and timing of CED discharges, including correlation with other case information to determine successful delivery and the effects of the discharges on the subject.
15. Assessment of the CED to establish whether it is operating within the manufacturer's specifications.
16. Preservation of the CED with batteries (since removal of batteries may alter the time clock) along with the darts and attached wires.
17. Investigation of the subject's place of residence or last place to visit to determine if additional medical history or evidence of drug use exists.

Assuming that the investigation and autopsy are performed and documented/reported in accordance with the National Institute of Justice's *Death Investigation; A Guide for the Scene Investigator* and the National Association of Medical Examiners' *Forensic Autopsy Performance Standards*,^{1,2} additional information and procedures that may be helpful, but not warranted in every case, are as follows:

1. Performance of a complete autopsy of the scope usually performed for deaths in-custody with appropriate histologic sampling of organs.
2. Comprehensive forensic toxicology of autopsy specimens and any retained antemortem samples, specifically including tests for alcohol, nervous system stimulants, common drugs of abuse, anti-seizure drugs, and therapeutic drugs often prescribed for psychiatric disorders.
3. Measurement of the thickness of the anterior chest wall from the skin to the rear of the pre-pericardial sternum at intercostal space between the left fourth and fifth ribs.
4. Measurement of the thickness of clothing and chest wall or tissue in the area(s) where CED darts or prongs penetrated.
5. Measurement of the depth of dart penetration.
6. Documentation of the CED dart's(s') length(s).
7. Documentation of dart and stun dart locations and any associated marks or burns.
8. Consideration of unusual or atypical current flow paths, such as body to ground, body to water, body to metal, etc.
9. Determination of the nature of any other forms of subdual or restraint that were employed in the case in question.
10. Removal and evaluation (interrogation) of any implanted cardiac or other electronic devices.
11. Utilization of appropriate consultants such as cardiologists, cardiac pathologists and neuropathologists as needed.

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The agency responsible for conducting the death investigation should ultimately be responsible for certifying the cause and manner of death.

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12. Considerations in Death Certification

The medical examiner/coroner is required to determine the cause and manner of death in all violent, sudden, and unexpected or unusual deaths. Consultant experts in various specialties may be involved as the case warrants. Any death related to CED deployment would fit into this category. Available publications describe basic principles regarding death certification and completion of the cause-of-death section of the death certificate (see also the definitions in the Glossary of this report).^{1,2} The manner of death classification (homicide, suicide, accident, natural or undetermined) is dependent on autopsy findings in conjunction with all relevant information, including the circumstances surrounding death as determined by a medically objective investigation independent of law enforcement.³

In a CED-related death, the medical examiner/coroner may choose to exclude any mention of the CED from the death certificate. In some cases, the death certificate may list the CED as a causative factor in Part I or as a contributory factor (other significant condition) in Part II of the cause-of-death statement. In other cases, the CED may be listed as one of the items in the space provided on the death certificate to describe how injury occurred. Further, the medical examiner/coroner may choose to classify a CED-related death as a homicide, whether the CED itself is directly causative or contributory, because the actions of law enforcement led to the death. In the majority of these cases, a subsequent (nonmedical) investigation would classify the homicide as justifiable, but it is beyond the scope of the medical examiner/coroner to make that determination for a death certificate. In other cases, including those that might list the CED on the death certificate in some way, the death may be ruled an accident, because the judgment of the medical examiner or coroner would be that the actions of law enforcement or others involved did not cause death.

Regardless of these classifications, an independent observer should use caution when interpreting the inclusion of a CED on a death certificate or the classification of the manner of death as a homicide as an absolute indictment of the CED as the sole or primary reason for the death. First, the CED-related deaths examined in this study involved a complex set of circumstances with individuals who were not necessarily healthy and who were often highly drug-intoxicated. These circumstances make it very difficult to point to the CED as a particular cause in specific deaths. Second, the decision to list the CED on the death certificate is subject to the judgment of the individual medical examiner/coroner and includes medicolegal considerations, experience, and often aspects of local practice and history.

Among the medical examiners on the panel that produced this report, many cases resulted in divergent views concerning cause and manner of death, although these disagreements were within the normal bounds of practice among certifiers of death. It is one objective of this report to minimize these differences among medical examiners and coroners by improving the scientific understanding of CED-related injuries and deaths. This is extremely important

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to medical examiners and coroners who must complete the death certificate and report the cause, manner and circumstances of death, including how injury occurred. A consensus is needed to make certification of death more consistent between cases and between jurisdictions, while always remaining aware of the need for professional judgment.

For deaths in which the subject is in law enforcement custody or is being apprehended, restrained or subdued, the medical examiner/coroner must often determine if the circumstances and findings are most consistent with a natural, accidental, homicidal or undetermined manner of death.

A major problem with the investigation of in-custody deaths and those in which a CED has been deployed is obtaining relevant and accurate information regarding the chronology of events leading up to the time when the subject underwent cardiopulmonary arrest during or following subdual or restraint. A limiting factor is that like all death investigations, in-custody death investigations occur after the fact over extended periods of time following the initial investigation of the scene and circumstances, and often rely on investigative information gathered by the same law enforcement agency involved in the subdual, restraint or deployment of a CED.

Both theoretical and real cases reviewed by the medical panel in which CED deployment was considered as a major factor in causing death were classified as homicide when there were accurate timelines, independent and objective witness accounts, and strong — almost immediate — temporal relationships between CED deployment and death. CED use in these instances could be responsible for initiating or contributing to a fatal sequence of events. It needs to be emphasized that the manner of death classification on a death certificate is not an assessment of legal responsibility for the death. From the medical examiner/coroner standpoint, homicide means that death either occurred at the hands of another person or resulted from hostile, illegal actions or inactions of another person. For example, deaths certified as homicide while in the “care” (i.e., custody) of another person have included the following types of situations:⁴

1. The caregiver has caused the death intentionally.
2. The caregiver lacks required licensure or training for the type of care being provided.
3. The caregiver consciously disregarded a known likelihood of injury and showed a wanton and gross disregard for the well-being of the patient (negligence).

In use-of-force deaths, the actions of law enforcement officers may be judged differently than those of other responders who are classified as “caregivers” even if the officers’ actions are very similar to those of emergency medical personnel.

In deaths following CED deployment, a certifier of death may determine that the manner of death was homicide; nonetheless, it may be determined that the officer was acting appropriately and the homicide was justifiable. Alternatively, the prosecuting attorney may

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pursue homicide charges if the law enforcement officer recklessly engaged in conduct and use of force that created a substantial risk of injury and was not compliant with policy or guidelines of the department (e.g. repetitive CED discharges when the subject has already been restrained and handcuffed, or administration of a CED to a compliant individual). In some cases, an accidental manner of death may be assigned if there is a lethal concentration of drugs or there are lethal complications of drug use, and subdual or CED use are clearly not factors contributing to death. In these cases, when the manner of death is classified as an accident, the certifier of death would be indicating that the actions of the law enforcement officer, whether appropriate or not, did not contribute to the death of the individual.

Certification of death following CED deployment can be difficult because:

- Information needed to draw conclusions may be of poor quality or not available.
- It may be impossible to determine the relative causative or contributory roles of underlying disease, drug intoxication, drug-induced agitation or delirium, restraint or subdual, or possible direct electrical or indirect stresses of CED deployment.

After thorough investigation, the certifier may be reasonably certain that CED deployment did or did not cause or contribute to death. In many cases, the role of CED deployment is much less clear.

There is debate as to whether CED deployment alone can directly cause death in humans via electrical effects on the cardiovascular or nervous system, as has been detailed elsewhere in this report. For the purpose of this discussion it is assumed that such a death may occur. For example, assume a young, thin, healthy person is not intoxicated, but is resisting arrest and receives several intentionally deployed, consecutive CED discharges to the anterior chest, then suddenly dies without other reasonable explanation and no other causative factors are identified. The death certificate could be worded as follows:

Part I	A. Sudden cardiac death
	Due to, or as a consequence of: B. Conducted energy device discharges
	Due to, or as a consequence of: C.
Part II	OTHER SIGNIFICANT CONDITIONS: Conditions contributing to death, but not resulting in the underlying cause of death in Part I

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Manner of Death Homicide	Describe how injury occurred Subdual by law enforcement
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If investigation shows a specific single form of restraint or subdual did cause death, such as head trauma with brain injury from a blow to the head, then death certification may follow this general example:

Part I	A. Skull fracture with brain contusions
	Due to, or as a consequence of: B. Blunt-force head injury
	Due to, or as a consequence of: C.
Part II	OTHER SIGNIFICANT CONDITIONS: Conditions contributing to death, but not resulting in the underlying cause of death in Part I
Manner of Death Homicide	Describe how injury occurred Struck during subdual by law enforcement for cocaine-induced agitation

More typically, however, multiple factors are involved such as:

- Repeated or prolonged deployment of the CED.
- Agitated state or delirium.
- Intoxication.
- Use of multiple methods of subdual or restraint.
- Acidosis, hyperthermia or rhabdomyolysis.
- Underlying natural disease such as heart disease, sickle cell trait, etc.

In these less clear-cut cases, the certifier may conclude that subdual contributed to death because of stress, often in conjunction with a drug-induced agitated state or disease. The questions become:

- Should all contributory factors be itemized or should they simply be combined under a general category of “stress of restraint” or “stress of subdual?”
- Would death have occurred when it did without the restraint?
- Should the manner of death be classified as other than homicide?

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For example, in a person with cocaine induced agitation and sickle cell trait who the certifier concludes died from subdual, one option for certifying the death is as follows:

Part I	Cocaine induced delirium resulting in physical subdual
	Due to, or as a consequence of: B.
	Due to, or as a consequence of: C.
Part II	OTHER SIGNIFICANT CONDITIONS: Conditions contributing to death, but not resulting in the underlying cause of death in Part I Sickle cell trait
Manner of Death Homicide	Describe how injury occurred Cocaine-induced agitation requiring multiple methods of subdual by law enforcement

In many cases, there are multiple forms of subdual or restraint such as carotid sleeper hold, pepper spray, handcuffing, hobbling, “hog-tying” slaps, asp baton strikes, chest compression, CED deployment, and others. Because it is difficult to differentiate contributory methods from noncontributory ones, and because of limited space in the “how injury occurred” section of the death certificate, it may be best to be generic in these complex cases and simply state that multiple forms of subdual or restraint were used. Of course, if there is reasonable evidence that one or more specific forms of subdual or restraint did cause death, such cases can be certified as described above. In general in these cases, CED deployment should be considered to be a stress of a magnitude that is comparable to other components of subdual.

Many times, law enforcement officers respond to violent or combative subjects and subdue or restrain them in order to facilitate medical care. Often, EMS will request law enforcement officers to come to a scene. In this capacity as a first responder, the distinctions between medical assistance and law enforcement procedures can be blurred. If a fatal injury results during medical assistance, the manner of death is usually classified as an accident. If the fatal injury results during a law enforcement action (even if the motivation is to provide medical assistance), the manner of death may be classified as homicide.

If there is insufficient information to differentiate between two manners of death, the manner of death may be certified as undetermined. Some examples in which an undetermined manner of death may be considered include the following:

- a) The autopsy and toxicology findings show no obvious cause of death.

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- b) Combinations of significant disease and toxicology results that ordinarily would not be fatal.
- c) When death is delayed after lengthy hospitalization and circumstantial details are not clear.
- d) No toxicology screen was done on admission to the hospital and death is delayed.
- e) Circumstances of the incident cannot be accurately determined.

Cases reviewed by the panel where CED was determined to be a major factor, and classified as homicides, were cases in which there was an accurate timeline, an independent witness observation, and strong, almost immediate, temporal relationship between CED use and death or initial/sudden collapse or unresponsiveness. When death or the initial/sudden collapse immediately follows CED use, one can reasonably conclude that the CED would be responsible for initiating a lethal sequence of events.

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Epilogue

The statements, opinions, and recommendations in this report were developed by consensus of the panel members. The opinions of the members may change in the future based on new studies and as more information becomes available. Indeed, the publication of numerous papers in the time between the release of the interim report and this final report was instrumental in determining the final recommendations published here. New data continue to accrue even during the preparation of this final report.

There was a good deal of discussion among the participants regarding the determination of cause and manner of death from a medicolegal viewpoint. Part of the discussion concerned our inability to make dogmatic statements about risk in many of these cases. There were also differing philosophies among participants underlying the placement of specific factors involved in a death within the chain of causation or contribution. As noted in the disclaimer at the beginning of this report, these differences do not reflect basic conceptual differences in the pathophysiology involved, but instead reflect conceptual differences about the meaning of cause and manner of death. In some cases, of course, the determination of cause and manner of death is explicit and noncontroversial. But in cases where the “real” cause must be teased from an interconnecting web of causal factors, differences in opinion will arise. That does not, however, remove the mandate of the medical examiner in most cases to assign a specific cause of death.

In addition to these essentially philosophical issues, the fact is that our knowledge and understanding of CED effects is incomplete. Indeed, there is uncertainty about how exactly CEDs achieve their effects on the human body. Some propose that the effects of CEDs are due entirely to electrically induced tetany, while others hypothesize secondary effects due to nerve stimulation and reflex effects. We do know that CEDs are characterized by the infliction of excruciating pain. While such a thorough comprehension may not be necessary to measure the physiologic effects on cardiac function, metabolism, respiration and mortality associated with CED deployment, it means that all recommendations are subject to revision as our understanding improves.

During discussions of the use of CEDs with stakeholders, interested parties and organizations, a recurring concern arose regarding the use of CEDs as punishment or torture devices. The panel shares the concern that wide deployment of an extremely safe method of delivering extraordinary pain could also potentiate abuse. Questions about the ethical infliction of pain in law enforcement are important, and we applaud efforts to address them, but they are not within the mandate of this panel. Instead, we emphasize that issues of safety are different and should not be conflated with these other important concerns.

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The panel extends its deep gratitude to the researchers and stakeholders who shared their knowledge, experience, and extraordinarily diverse perspectives. We greatly appreciate the efforts of the National Institute of Justice in funding and providing logistical support. We thank our respective employers, institutions, universities and our families for allowing us the time and opportunity to perform this function. We extend our respect and thanks to those in law enforcement and the military who protect our lives, liberty and property. We recognize our duty to the citizens of these United States, whom we serve and who deserve our best efforts to ensure that their lives and rights are preserved.

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Glossary of Terms as Used in This Report

Acidosis — An increase in the acidity (decrease in pH) of the blood; the normal pH of human blood is 7.4.

Adrenergic response — The epinephrine (adrenaline or catecholamine) response to stress such as occurs with the “fight or flight” reaction.

Alligator clip — A small metal clip, which is hinged and has teeth, so it resembles the snout, jaws and teeth of an alligator. In CED research, it is used to attach wires to a research subject’s clothing.

Apex (of the heart) — The tip (bottom) of the heart closest to the diaphragm.

Cardiac dysrhythmias (arrhythmias) — Abnormal heart rhythms. These can spontaneously resolve in some instances:

- **Asystole** — Lack of electrical activity and heart function.
- **Atrial fibrillation** — An abnormal heart rhythm where the upper chambers (atria) are fibrillating (quivering in an unsynchronized fashion). The atria fail to augment heart output and often cause the heart to beat very rapidly.
- **Pulseless electrical activity (PEA)** — A state where electrical activity can be recorded from the heart but there is not enough blood flow out of the heart to maintain a pulse or blood pressure.
- **Ventricular capture (pacing)** — The ability of an external source of energy to cause the lower chambers (ventricles) of the heart to beat.
- **Ventricular fibrillation** — An abnormal rapid heart rhythm originating in the lower chambers of the heart. This rhythm does not support flow of blood out of the heart, causing lack of blood pressure or pulse. This rhythm typically leads rapidly to unconsciousness and death.
- **Ventricular tachycardia** — An abnormal rapid heart rhythm originating in the lower chambers of the heart. This rhythm may allow for adequate blood pressure to support life for a period of time, but may also rapidly lead to death.

Cardiac mechanisms — The ways the heart can fail when injured or sick.

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Conducted energy device (CED) — A weapon primarily designed to disrupt a subject's central nervous system by means of deploying electrical energy sufficient to cause uncontrolled muscle contractions and override an individual's voluntary motor responses.

Darts — Projectiles that are fired from a CED and penetrate the skin; wires are attached to the darts leading back to the CED.

Dart removal — The act of removing a dart from a person's body or clothing.

Deployment — Making an item available for use in the field or actually using it in the field. In this report, deployment means use of the CED on a subject.

Diabetic ketoacidosis — A metabolic abnormality in diabetics which is characterized by elevated blood sugar and ketones, and may cause abnormal mental function.

Duration — The aggregate period of time that CED shocks are activated.

Dysrhythmia — Any disturbance or irregularity of the heartbeat.

Echocardiography — Ultrasound study of the heart.

Electrocardiogram — A graphic produced by an electrocardiograph, which records the electrical activity of the heart over time.

Electro muscular disruption — The effect that a CED has on the body. Overrides the brain's communication with the body and prevents voluntary control over the muscles.

Emotionally disturbed person (EDP) — A generic term often used by criminal justice and law enforcement personnel to describe a person with behavioral disturbances which may be caused by a mental disorder, disease, or a chemically induced state.

Excited delirium — State of extreme mental and physiological excitement, characterized by extreme agitation, hyperthermia, euphoria, hostility, exceptional strength and endurance without fatigue.

Hypoventilation — Breathing slower or less deeply than normal, thereby increasing the amount of carbon dioxide (CO₂) in the blood to above normal.

Implantable cardiac device — An electronic device surgically implanted in a person and usually consisting of a cardiac pacemaker, defibrillator or combination pacemaker/defibrillator.

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- **Implantable cardiac defibrillator** — An implanted cardiac device which has the ability to recognize and treat abnormal rhythms of the heart. This device can function as a pacemaker but is also designed to treat life-threatening rhythms such as ventricular tachycardia and ventricular fibrillation. The device treats these rhythms by either shocking the heart or rapidly pacing the heart back to a normal rhythm.
- **Pacemaker** — An implanted cardiac device which causes the heart to beat when the heart is beating too slow.

Less lethal — A concept of planning and force application that meets an operational or tactical objective, with less potential for causing death or serious injury than conventional, more lethal police tactics.

Less-lethal weapon — Any apprehension or restraint device that, when used as designed and intended, has less potential for causing death or serious injury than conventional police lethal weapons.

Metabolic mechanisms — The ways the metabolism can fail when a person is injured or sick.

Pacing threshold — The amount of energy required from a pacemaker to cause the heart to beat.

Paranoid schizophrenia — A psychotic state in which a person has paranoid delusions (false beliefs or altered perceptions of reality).

Physical mechanisms — The ways in which illness or injury can compromise heart/lung function or put body metabolism at risk.

Pulmonary mechanisms — The ways in which lung function can be compromised by injury or sickness.

Pulse rate — The frequency at which electrical pulse waves are generated.

Pulse wave — A graphic measurement of the wave produced by an impulse of electric energy.

Respiratory — Relating to the act or process of inhaling (breathing in) and exhaling (breathing out); breathing, also called ventilation.

Restrain — To control, limit, or prevent movement.

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Restraint — A device that restricts movement.

Rhabdomyolysis — Potentially fatal condition resulting from the breakdown of muscle fibers resulting from metabolic, physical or chemical causes, producing substances that can damage other organs such as the kidneys.

Sensitive areas — A person's head, neck, and genital areas, and a female's breast areas.

Standard CED cycle — A five-second electrical discharge occurring when a CED trigger is pressed and released. The standard five-second cycle may be shortened by turning the CED off. (Note: If a CED trigger is pressed and held beyond five seconds, the CED will continue to deliver an electrical discharge until the trigger is released.)

Sternal notch — The depression in the skin just above the breast bone where the neck connects to the chest.

Subdual — To bring under control.

Sympathomimetic — A chemical agent or physiologic response which mimics or increases bodily responses typically caused by the sympathetic nervous system, often due to agents such as cocaine and amphetamine compounds which increase adrenaline (epinephrine), or neurotransmitters such as dopamine.

Symptomatology — The combined symptoms of a disease: the symptom complex of a disease.

Vector — The angle or course of current in this example.

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Appendix A. How a TASER® Conducted Energy Weapon Works

PART 3: CONDUCTED ENERGY WEAPONS

Braidwood Commission on Conducted Energy Weapon Use

Models commonly used by Law Enforcement **TASER M26 and TASER X26.**

a. The Advanced TASER M26

Introduced to the law enforcement community in 1999, the Advanced TASER M26 is a pistol-shaped weapon. It can be used in two modes:

- ***Push-stun mode*** — the end of the weapon is pressed against the target's body (with an expended cartridge attached or without a cartridge attached), and a pulsed electrical current is transferred to the adjacent muscles; or
- ***Probe mode*** — when a cartridge is attached to the end of the weapon, it fires two metal darts or probes (using compressed nitrogen as a propellant), which imbed in the target's skin or clothing. The probes, which have hooked tips, can penetrate up to 9 mm into the subject's skin. If the probes do not reach the skin due to bulky clothing, the high voltage creates an arc enabling the current to enter the body. The probes are connected to the weapon by wires that conduct a pulsed electrical current from the weapon into the target's body.

The trigger activates a five-second electrical current cycle, which can be stopped by placing the safety lever in the safe position, or can be repeated by re-pressing the trigger after the completion of the first cycle. Holding the trigger down continuously can extend a cycle.

Eight AA nickel metal hydride or alkaline cell batteries power the M26. Depending on the battery brand used, the electrical current has a pulse rate of 15 or 20 pulses per second, with a pulse duration of 40 microseconds (40 millionths of a second) full waveform. When the M26 is held level, the upper probe is propelled in a horizontal direction and the lower probe is propelled at an eight-degree downward angle, which means that, for every seven feet of travel, there is a one-foot spread between the probes (or, for every 2.1 metres of travel, there is a 0.3 metre spread). Four different colour-coded single-use cartridges can be installed, with different wire lengths — yellow (15 feet), silver (21 feet), green (25 feet), and orange (35 feet). For the M26 to be effective when used in its probe mode, both probes should hit the subject. To assist the officer in aiming, the M26 emits a red laser beam, which marks where the upper probe will hit the target. Every cartridge has a unique serial number. When it fires out the two probes and wires, it also disperses about 30 small discs, called Anti-Felon Identification tags, with the same serial number on it. This enables investigators to link up the user of the weapon with the person to whom the cartridge was issued. The M26 has an LED indicator showing that the laser is on and the weapon is capable of firing, but it does not indicate whether there is sufficient battery power to fire or discharge. The weapon stores

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data about firings, date, and time for approximately 585 firings, which can be downloaded using an M26 dataport download kit. The manufacturer's specifications respecting the M26's electrical output, which I will discuss in more detail later, include the following:

- Voltage:
 - Peak open circuit arcing voltage — 50,000 V
 - Peak loaded voltage — 5,000 V
 - Average voltage over duration of main phase — 3,400 V
 - Average voltage over full phase — 320 V
 - Average voltage over one second — 1.3 V
- Current: 3.6 mA average (milliamps)
- Energy per pulse:
 - Nominal at main capacitor — 1.76 joules
 - Delivered into load — 0.50 joules
- Power rating:
 - Nominal at main capacitor — 26 watts at 15 pulses per second
 - Nominal delivered into load — 7.39 watts at 15 pulses per second

However, Mr. Reilly testified that an electrical shock can be delivered across several inches of air and if one probe hits the subject and the other probe falls on wet ground, the subject may still receive a shock.

b. The TASER X26

The manufacturer introduced its X26 model, for law enforcement and military use, in 2003. It was more compact, 60 percent lighter, and designed to be carried in a holster on an officer's service belt. The X26's specifications are similar to the M26, except for the following:

- Batteries — digital power magazine (two 3-volt lithium batteries, as used in digital cameras)
- Pulse rate — 19 pulses per second
- Pulse duration — 100 microseconds (100 millionths of a second)
- Peak loaded voltage — 1,200 V
- Average voltage over duration of main phase — 400 V
- Average voltage over full phase — 350 V
- Average voltage over one second — 0.76 V
- Current — 2.1 mA average
- Energy per pulse:
 - Nominal at main capacitors — 0.36 joules
 - Delivered into load — 0.07 joules
- Power rating:
 - Nominal at main capacitors — 6.84 watts
 - Delivered into load — 1.33 watts

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- LED display — a two-digit display of remaining digital power magazine energy percentage, burst time, warranty expiration, unit temperature, illumination status, and current time and date.
- Data storage — stores time, date, burst duration, unit temperature, and remaining digital power magazine energy percentage for approximately 1,500 firings. The data can be downloaded using a USB data interface module.
- Video and audio — available with an optional video and audio recorder that is activated when the safety switch is armed. It is capable of recording for up to 90 minutes.

In order to understand how a conducted energy weapon works, a basic understanding of electricity is required. I am indebted to Mr. J. Patrick Reilly, from the Applied Physics Laboratory of Johns Hopkins University, for his very informative presentation during our public forums. Much of the explanation that follows is based on what he said and his PowerPoint presentation.

To begin with a question, if putting my finger into a 120-volt light socket could kill me, why could I walk away from a 50,000-volt shock from a conducted energy weapon? There are two reasons. First, the “peak open circuit arcing voltage” is rated at 50,000 volts when nothing is connected to the probes, such as when the officer is testing the weapon by creating an electrical arc between the two electrodes. When the weapon is under load (such as when imbedded in a person’s skin or clothing), the voltage is much less — 7,000 volts for the M26 and 1,300 volts for the X26, according to Mr. Reilly. Second, the duration of the conducted energy weapon pulse is short. In the case of the wiring in our homes, the electrical current is continuous. However, in a conducted energy weapon, a new electrical pulse begins 19 times every second. The actual duration of each of these pulses is much briefer — 30 microseconds (30 millionths of a second) with the M26 and 80 microseconds (80 millionths of a second) with the X26. The pulse durations of 30 and 80 microseconds are taken from Mr. Reilly’s presentation. According to the manufacturer’s specifications, the pulse durations are 40 and 100 microseconds for the M26 and X26 respectively.

There is an important reason why a conducted energy weapon needs 50,000 volts. This voltage (analogous to pressure in a water hose) is required in order to create an electric arc that bridges an air gap. For example, if one of the probes is imbedded in clothing and does not touch the skin, the high voltage creates an arc between the probe and the skin, enabling the electrical current to enter the body. Similarly, although the outer layer of a person’s skin (the corneum) is dry and normally a poor conductor, the high voltage breaks down the dryness and makes the skin a good conductor.

Turning now to current (analogous to the water flow rate in a hose, such as litres per minute), the manufacturer’s specifications state that the M26 has a current of 3.6 milliamps (3.6 thousandths of an ampere) average, and the X26 has a current of 2.1 milliamps (2.1 thousandths of an ampere) average. Mr. Reilly, on the other hand, cites the M26 as having a

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peak output current of 17 amperes, and the X26 as having a peak output current of 3 amperes. He explained the difference between his numbers and the manufacturer's numbers as follows. His numbers measure the actual amperage during a pulse, whereas the manufacturer's numbers are an average over the total time period, during and between pulses. In his view, average current is irrelevant to electrostimulation.

According to Mr. Reilly, "delivered charge" is the best indicator of the potential electrostimulation. It is measured in coulombs, which is analogous to the volume of water delivered by a hose during a set period of time. The significant point is that both the M26 and the X26 have an almost identical "delivered charge" for each pulse — approximately 100 micro-coulombs (or 100 millionths of a coulomb). This is so because of the differing currents and pulse durations of the two models, as shown in Table 1.

Table 1. Delivered charge of M26 and X26 models

	<i>M26</i>	<i>X26</i>
Current	17 amperes per pulse	3 amperes per pulse
Pulse duration	30 microseconds	80 microseconds

To give a sense of what effect 100 micro-coulombs of delivered charge would have on a person, Mr. Reilly conducted laboratory experiments with human subjects, who were subjected to brief high-voltage pulses on their forearms. Subjects reported pain on average at 0.5 micro-coulombs, and intolerable pain at 1.0 micro-coulombs. This is to be contrasted to the delivered charge of 100 micro-coulombs from each pulse of a conducted energy weapon, which delivers 95 pulses over a five-second period.

The purpose of the electrical current is different, depending on the mode used:

- ***Push-stun mode*** — if the trigger is pulled when the end of the conducted energy weapon is pressed against the person's skin (*e.g.*, arm). The electrodes are close together, which means that the electrical current is localized to the muscles in that area. In that case it serves a pain compliance purpose, to persuade the person to let go of something, or to otherwise comply in order to avoid further shocks.

- ***Probe mode*** — when the probes are deployed they are normally imbedded in the person farther apart than the electrodes are in the push-stun mode. In that case, the electrical current spreads out more and goes deeper into the body, engaging more and more excited tissue. In addition to the same pain experienced in the push-stun mode, the electrical current now interferes with the person's neuromuscular system. The person typically becomes incapacitated, and falls to the ground with no ability to put his or her hands out to break the fall.

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When the five-second cycle is over, the pain and/or incapacitation is over, and the person's normal strength returns immediately.

From the Braidwood Commission of Inquiry. *Restoring public confidence: Restricting the use of conducted energy weapons in British Columbia*. Victoria, British Columbia: Braidwood Commission on Conducted Energy Weapon Use. 2009.

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Appendix B. Definitions for Cause, Mechanism and Manner of Death

Background, The study steering group presented definitions for Cause, Mechanism and Manner of Death for review and comment by the Medical Panel in January 2008. The definitions herein were revised in April 2008 and will serve to guide mortality reviews of those cases of interest to the study.

The underlying (or proximate) cause of death is

(a) the disease or injury, or combination of the two, that initiated the pathophysiologic sequence of events leading to death
OR

(b) the circumstances of the event [accident or violence] that produced the fatal injury.

The proximate cause of death is always etiologically specific.

The **immediate cause of death** is the terminal disease, injury, medical complication or pathophysiologic condition resulting from the underlying cause or circumstance and directly preceding death.

The underlying cause of death and the immediate cause may either exist simultaneously or be separated by variable spans of time.

An **intermediate (or intervening)** cause of death is a disease or condition with fatal potential that occurs at any time between the underlying cause of death and the immediate cause of death and is a result of the underlying cause.

There may be no, one or multiple intermediate causes of death.

A **contributory cause of death** is any or all significant disease[s], injuries, or pathophysiologic condition[s] that existed at death and that may have fatal potential, but did not lead to or result in the underlying cause of death.

There may be no, one or multiple contributory causes of death.

The **mechanism of death** constitutes the fatal pathophysiologic derangement[s] resulting from the underlying cause of death.

The mechanism of death is one or more complication[s] of the underlying cause of death, and:

- Is a disturbance of physiology and/or biochemistry.
- Is the derangement by means of which the underlying cause of death effects the lethal outcome.

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- May have more than one cause.
- Is never etiologically specific.

The **manner of death** is a classification of the circumstances of how death occurred. It is derived from correlation of all investigative and scientific components of the death investigation.

In most jurisdictions in the United States the subdivision of manner of death is as follows:

- **Natural** — Solely due to disease processes.
- **Unnatural (or violent)** — Due to external agencies (injury of any kind, including the toxic effects of chemicals) either exclusively or in concert with natural conditions. These may be:
 - Homicide.
 - Suicide.
 - Accident.
- **Undetermined** — When neither unnatural nor natural manner of death can be determined — OR — if the cause of death is known to be unnatural, but investigation cannot distinguish the subcategories.

Guidelines for Cause (COD) and Manner (MOD) of Death as Used in This Document:

Cause and manner of death are the medical opinions of the certifier based on information available at the time of certification.

COD — Reasonable medical and investigative probability, or a preponderance of all scientific and investigative data.

MOD — Reasonable discretion by the investigating certifier, correlating all pertinent case data.

Cause and manner of death are subject to change if new information relevant and material to the investigation emerges.

(N.B. — Certification of a death as homicide does not imply criminal culpability, which is a determination solely in the jurisdiction of the justice system.)

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Appendix C. The Use-of-Force Continuum

Most law enforcement agencies have policies that guide their use of force. These policies describe an escalating series of actions an officer may take to resolve a situation. This continuum generally has many levels, and officers are instructed to respond with a level of force appropriate to the situation at hand, acknowledging that the officer may move or skip from one part of the continuum to another in a matter of seconds.

An example of one of many use-of-force continuums follows:

- **Officer Presence — No force is used. Considered the best way to resolve a situation.**
 - The mere presence of a law enforcement officer works to deter crime or diffuse a situation.
 - Officers' attitudes are professional and nonthreatening.
- **Verbalization — Force is not physical.**
 - Officers issue calm, nonthreatening commands, such as "Let me see your identification and registration."
 - Officers may increase their volume and shorten commands in an attempt to gain compliance. Short commands might include "Stop," or "Don't move."
- **Empty-Hand Control — Officers use bodily force to gain control of a situation.**
 - **Soft technique.** Officers use grabs, holds and joint locks to restrain an individual.
 - **Hard technique.** Officers use punches and kicks to restrain an individual.
- **Less-Lethal Methods — Officers use less-lethal technologies to gain control of a situation.**
 - **Blunt impact.** Officers may use a baton or projectile to immobilize a combative person.
 - **Chemical.** Officers may use chemical sprays or projectiles embedded with chemicals to restrain an individual (e.g., pepper spray).
 - **Conducted energy devices (CEDs).** Officers may use CEDs to immobilize an individual. CEDs discharge a high-voltage, low-amperage jolt of electricity at a distance. (See chapter 9 on Research Associated With the Decision to Use a CED)

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- **Lethal Force** — Officers use lethal weapons to gain control of a situation. Should only be used if a suspect poses a serious threat to the officer or another individual.
 - Officers use deadly weapons such as firearms to stop an individual's actions.

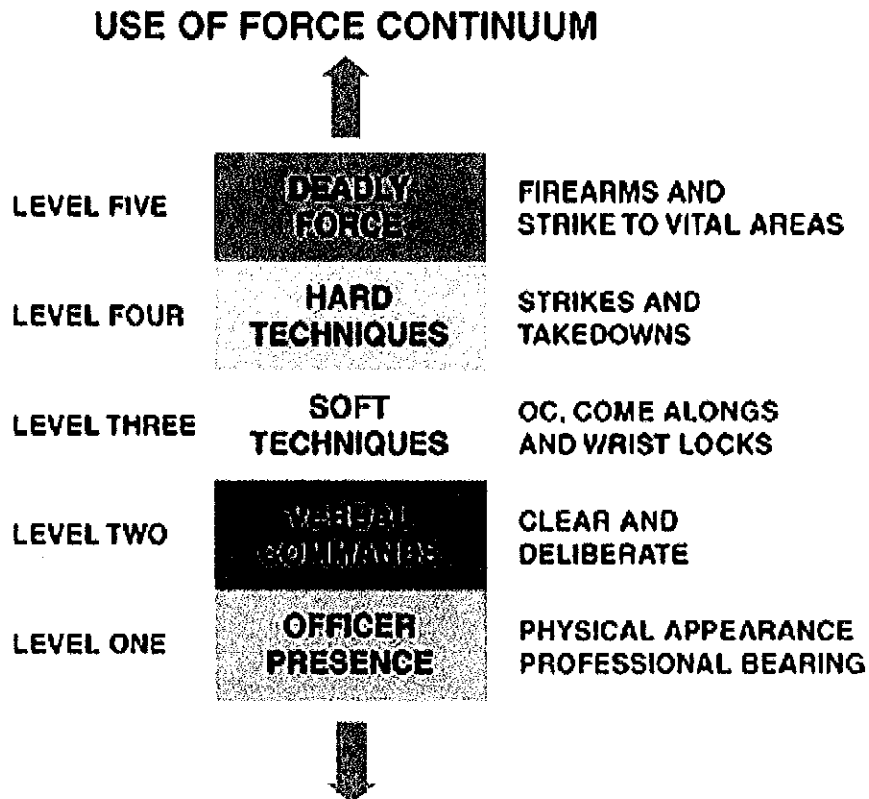


Figure 1. Descriptive diagram of one of many use-of-force continuums

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Appendix D: List of Acronyms Used in this Report

List of Acronyms Used in This Report

CED: Conducted energy device
COD: Cause of death
ECG: Electrocardiograph/electrocardiographic
EDP: Emotionally disturbed person
EMD: Electro muscular disruption
EMS: Emergency medical service(s)
ExD: Excited delirium
JNLWD: Joint Non-Lethal Weapons Directorate
kJ: kilojoule
kV: kilovolt
LED: Light-emitting diode
mA: milliamperere
mJ: millijoule
MOD: Manner of death
NIJ: National Institute of Justice
NMI: Neuro muscular incapacitation
PEA: Pulseless electrical activity
USB: Universal service bus
V: volt
VF: Ventricular fibrillation
VT: Ventricular tachycardia

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- The Omnibus Crime Control and Safe Streets Act of 1968, amended (see 42 USC §§ 3721-3723)
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