

Cardiac, Physiologic, and Real World Effects of Taser Use

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Conducted Energy Device Meeting
San Francisco Police Department

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Disclosures

Research Support:

- National Heart, Lung, Blood Institute (NHLBI), National Institutes of Health (NIH), Centers for Disease Control (CDC)
- PI: San Francisco POST SCD Study (POstmortem Systematic InvesTigation of Sudden Cardiac Death)
- Site PI: CDC/NHLBI Sudden Death in the Young Registry

Consulting:

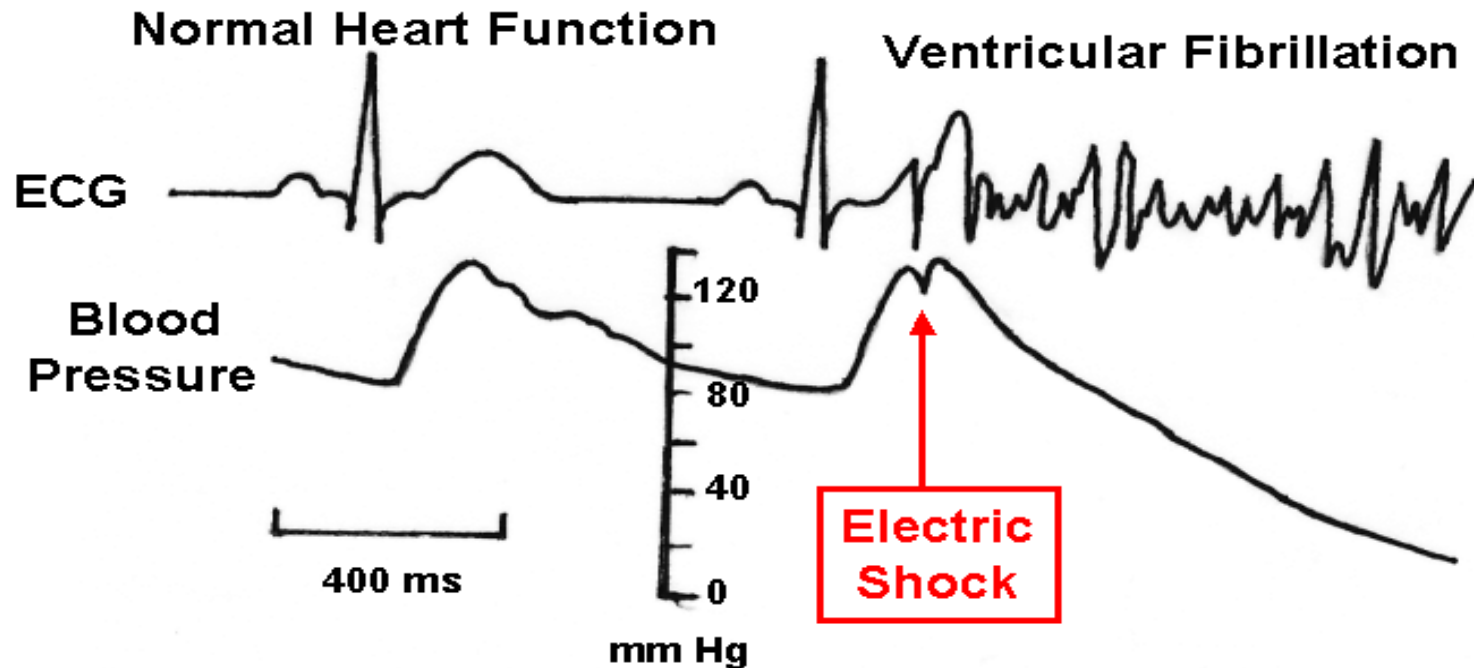
- Medical Consultant for Taser policy Braidwood Commission, 2008-09, Government of British Columbia, Canada
- Medical Consultant for Taser policy UCSF Police Department, 2016

Legal:

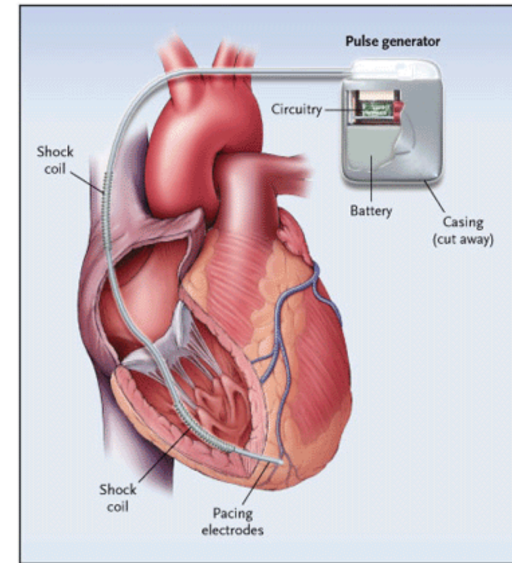
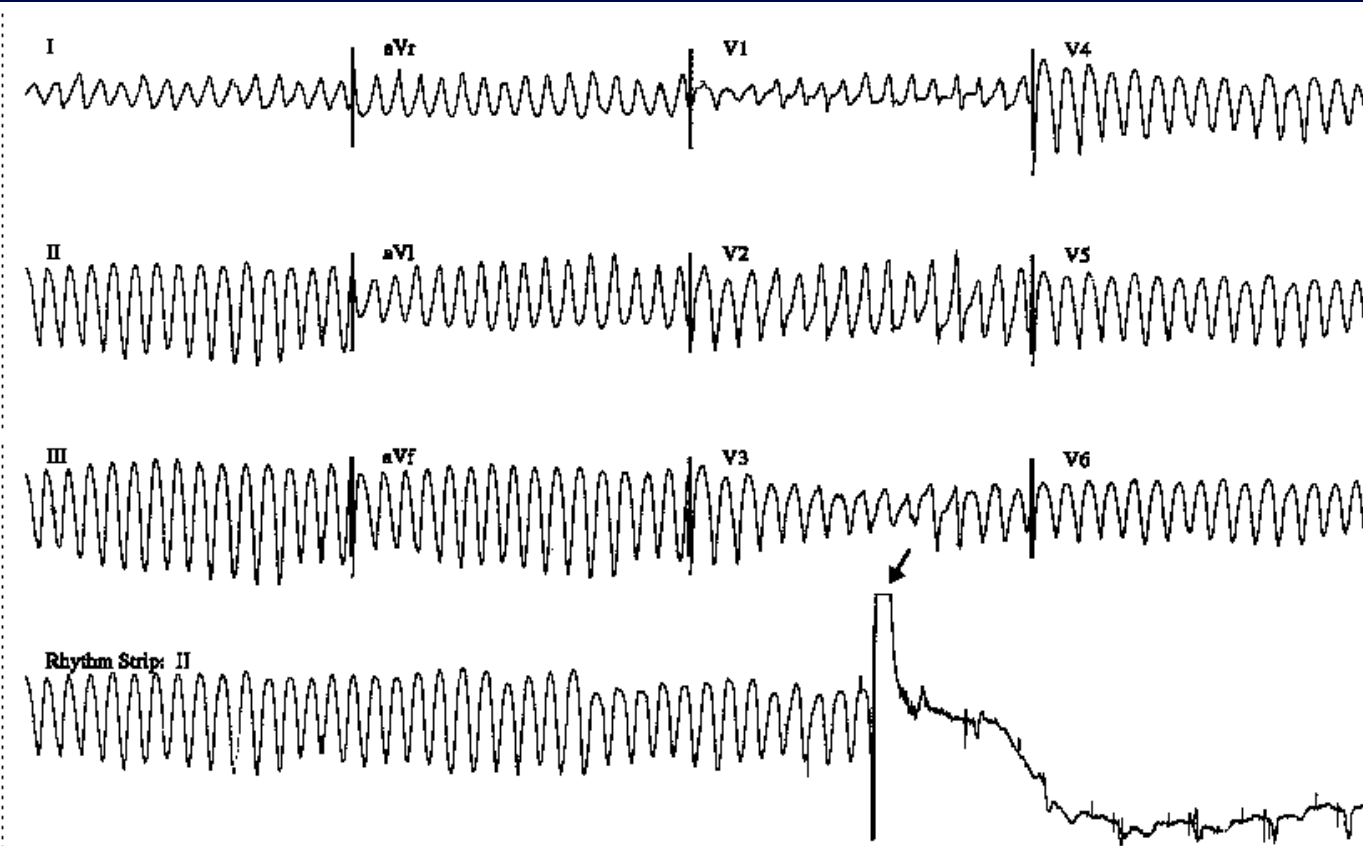
- *NONE*

Induction of Cardiac Arrest (VF) with T shock

Heart Function and Electric Shock

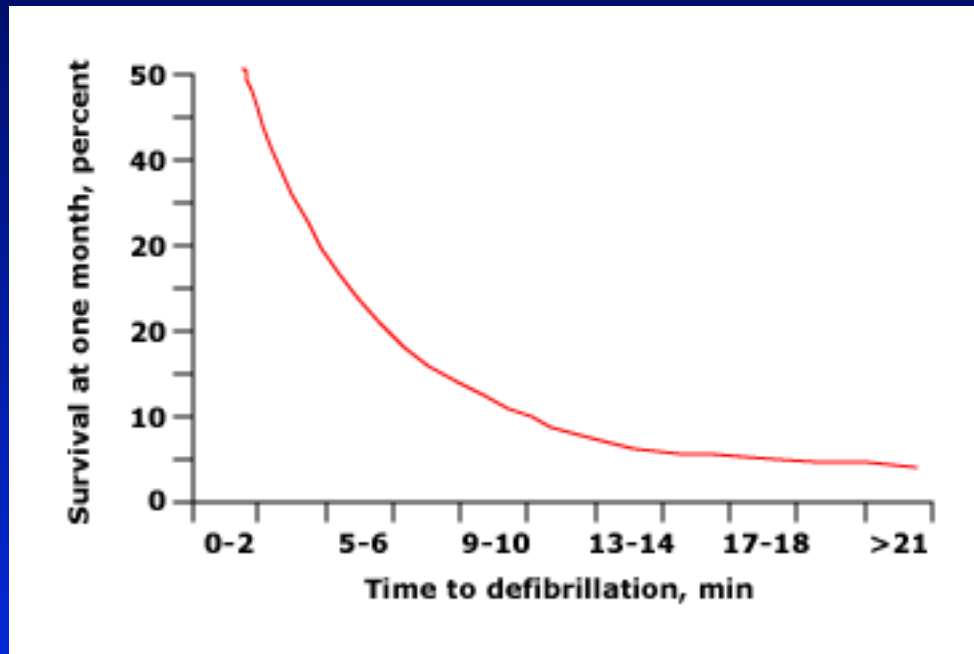


Resuscitation from Cardiac Arrest (VF)



Resuscitation from VF

- Time to defibrillation is key for survival:



Risk Factors for Cardiac Arrest

- Underlying cardiac disease
 - Previous myocardial infarction (heart attack)
 - Heart failure
- High adrenaline
 - Cardiac arrests most common early in AM when adrenaline highest
 - Cardiac arrests surge with stressful events: earthquakes, disasters
- Illicit drugs: cocaine, methamphetamines
- Acidosis (diabetics)
- Thin body habitus

Physiologic Effects of Taser Application

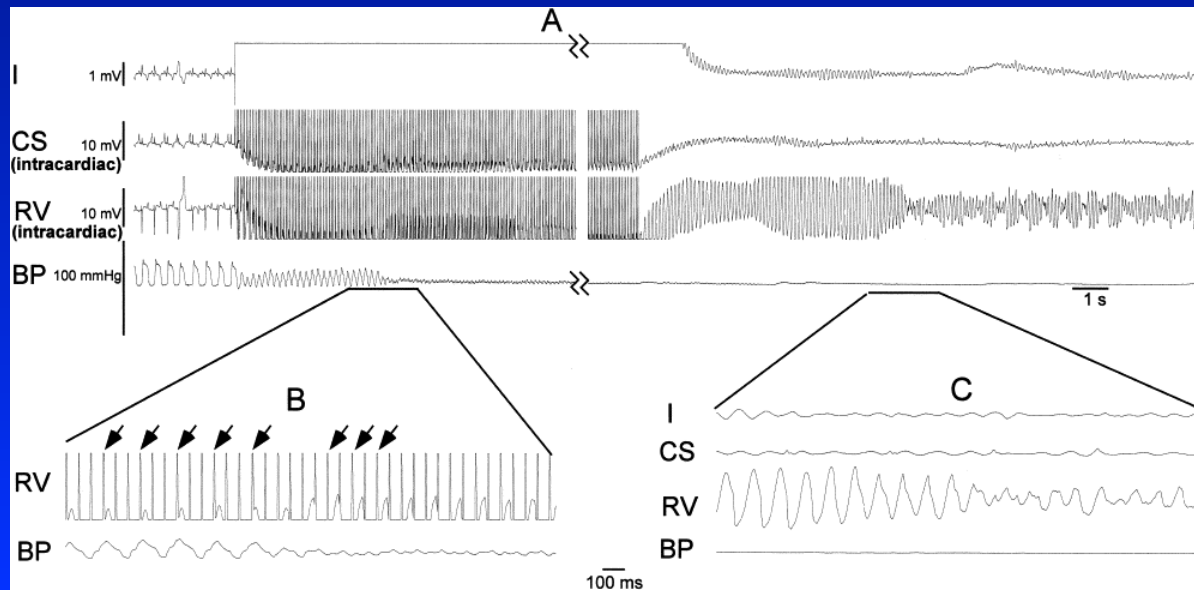
- Effects increase with duration of application
- Electrically overwhelming voluntary control of muscles = “induced seizure”
- Intense pain
- Dazed, immobilized, weak for 5-15 min after application
- Eye injury, miscarriage, brain penetration
- Acidosis from rhabdomyolysis (muscle death and injury)

Physiologic Effects of Taser Application

- *Immediate effects: Due to electrical cardiac capture*
 - Cardiac arrest and sudden death (VF)
 - May be no autopsy findings for death due to VF
- *Indirect/delayed health effects: Due to pain, adrenaline, acidosis*
 - Myocardial infarction = “heart attack” = death of heart muscle
 - asthmatic attack
 - “excited delirium”
 - seizures

Taser Animal Studies

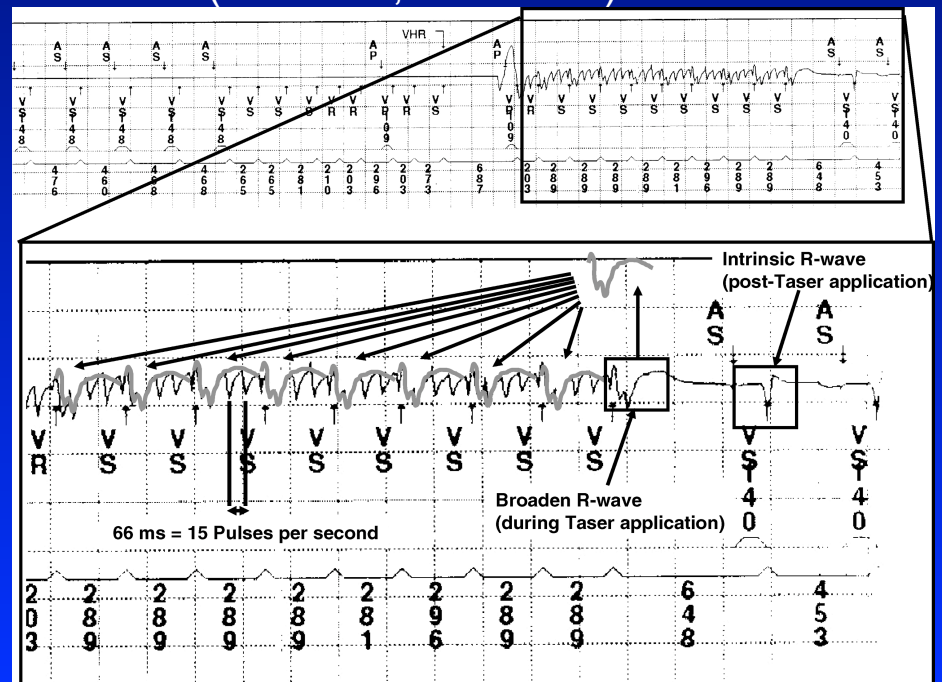
- 2 Taser-funded animal studies show no VF induction (Lakkireddy, et al *JACC* 2006; McDaniel, et al *PACE* 2005)
 - Taser simulator used
- 3 independent animal studies show VF induction during Taser discharge (Nanthakumar et al, *JACC* 2006; Dennis et al, *J Trauma* 2007; Walter et al, *AED* 2008)
 - Vector over heart is critical, up to 81% VT/VF rate



Taser Human Studies

- 3 studies in resting, healthy police volunteers, typically Tasered in the back show tolerability
- Taser-induced rapid ventricular arrhythmia demonstrated by pacemaker (Cao et al, *JCE* 2007)

- University funded
- Vector across chest
- Myocardial capture at >240 bpm



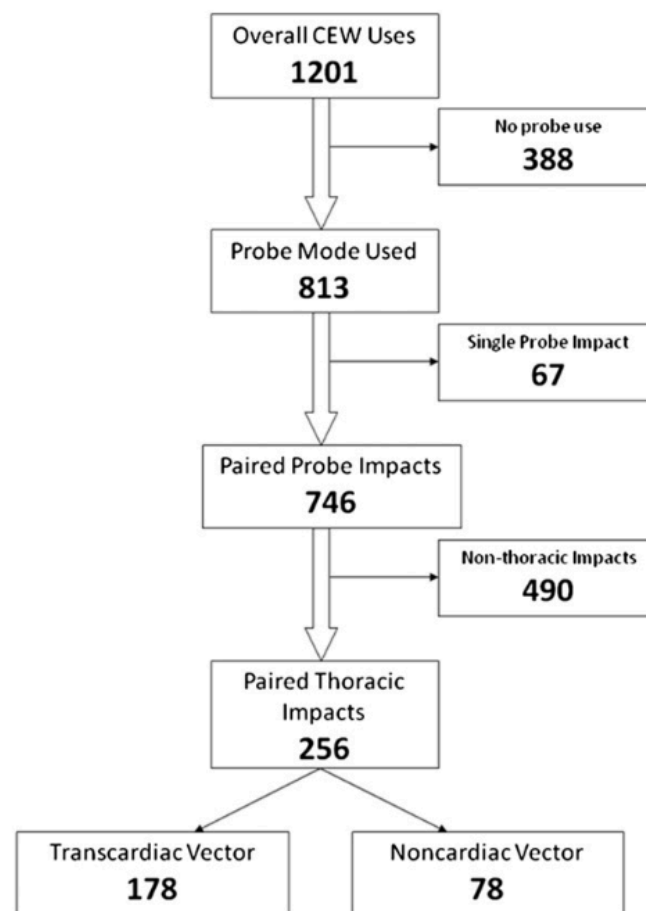
TRANSCARDIAC CONDUCTED ELECTRICAL WEAPON (TASER) PROBE DEPLOYMENTS: INCIDENCE AND OUTCOMES

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- Reports reviewed in a use of force database to identify cases in which Taser was used
- Found 178 uses from 6 cities in which Taser was used across chest
- No reported sudden deaths or fatal cardiac rhythms



Arrhythmia/Electrophysiology

Sudden Cardiac Arrest and Death Following Application of Shocks From a TASER Electronic Control Device

Douglas P. Zipes, MD

Circulation. May 2012; 125: 2417-2422

- 8 cases of Taser-induced sudden arrest were analyzed
- Rhythm was VF in 7 cases, asystole in 1

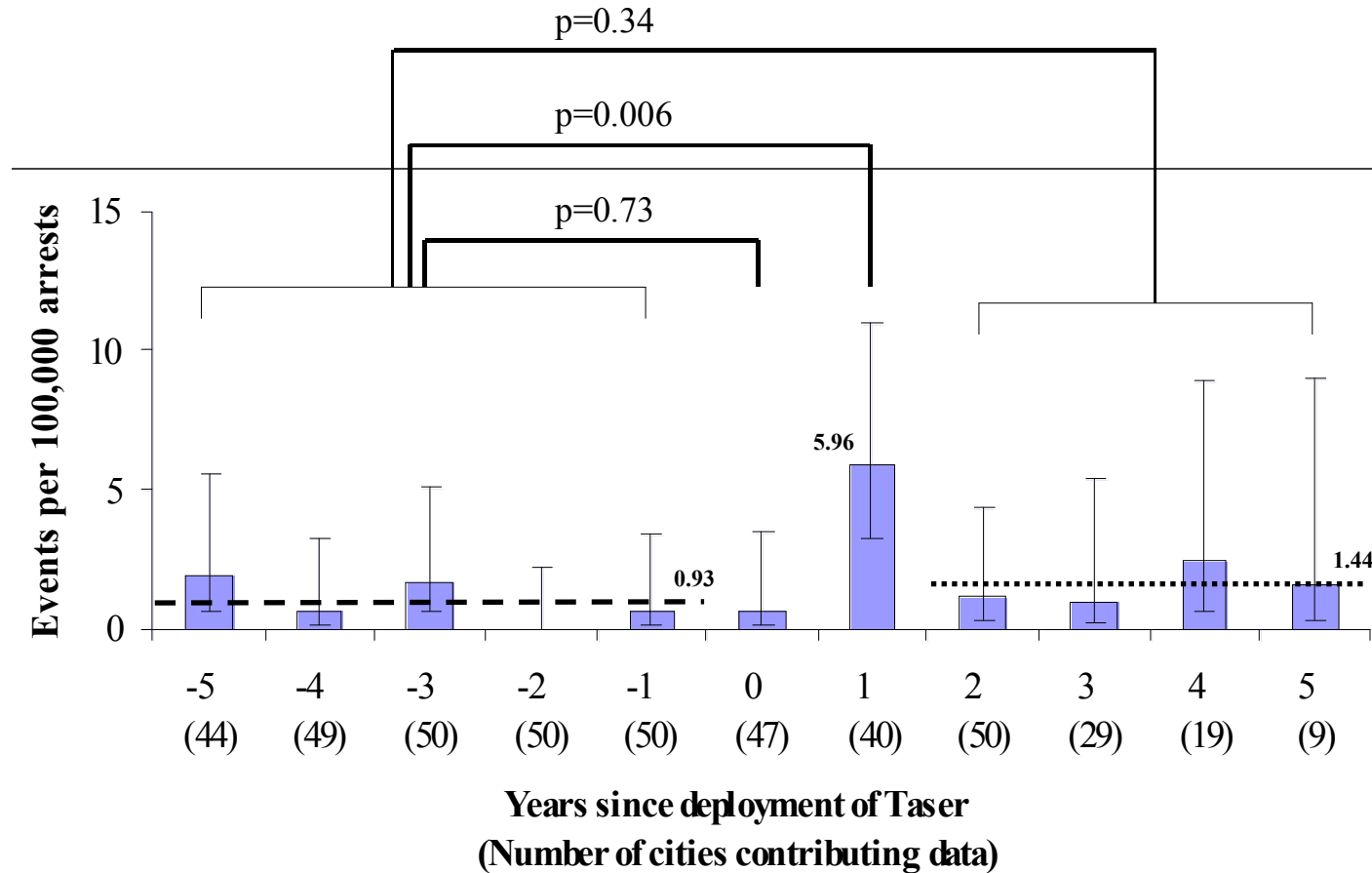


Relation of Taser (Electrical Stun Gun) Deployment to Increase in In-Custody Sudden Deaths

Byron K. Lee, MD^a, Eric Vittinghoff, PhD^c, Dean Whiteman, BS^a, Minna Park^a, Linda L. Lau, BS^b,
and Zian H. Tseng, MD^{a,*}
American Journal of Cardiology. 2009 Mar 15; 103(6):877-80)

- In the real world setting, do Tasers impact rates of:
 - In-custody sudden deaths, firearm deaths, officer injuries
- Surveys and Public Records Request were distributed to 126 cities in California using Tasers
- Analyzed data from 50 California cities using Tasers
 - 9 of 10 largest US cities refused to provide data
- Event rates recorded for each city over a 10-year period: 5 y before through 5 y after Taser use

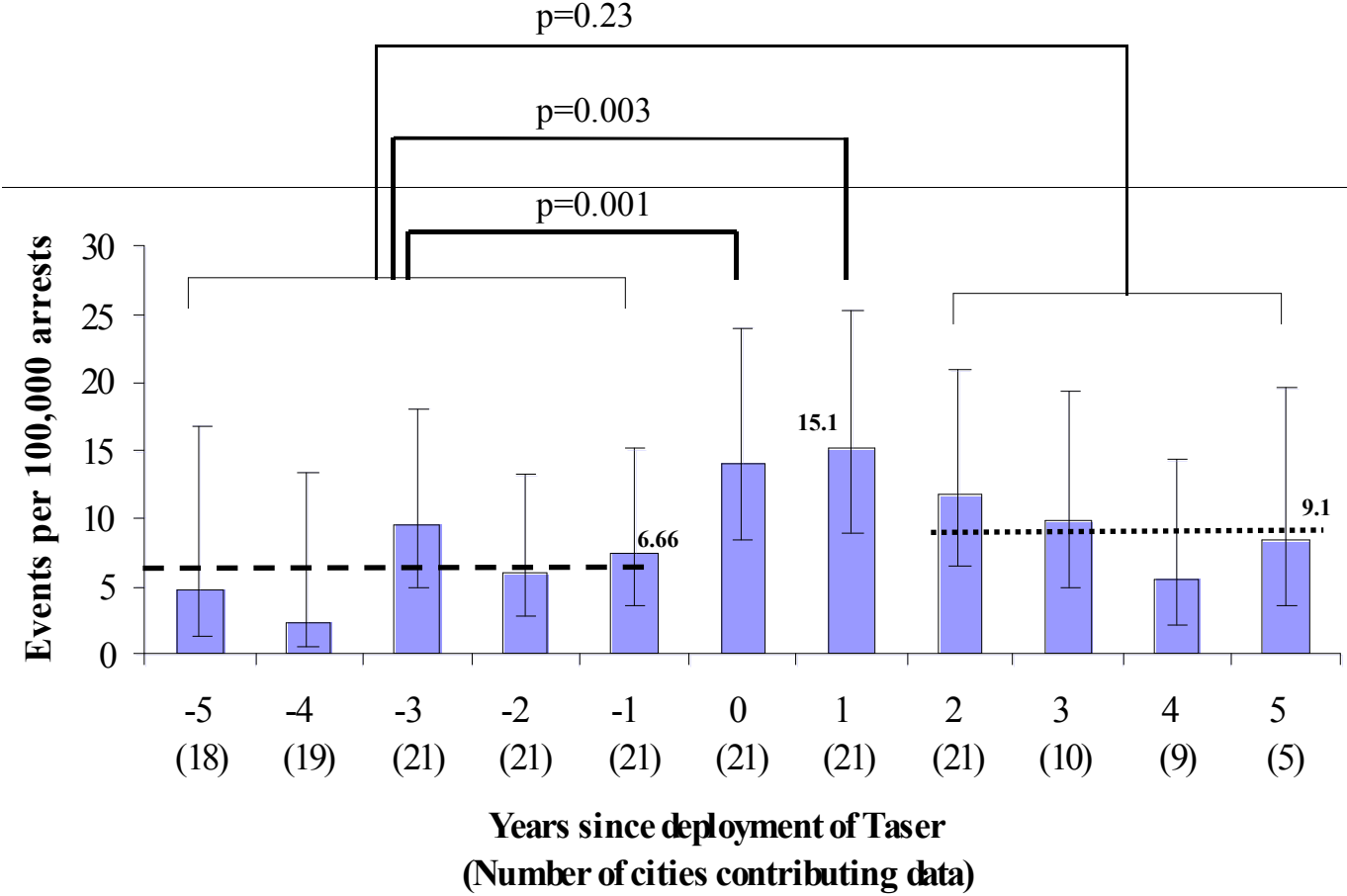
Rates of In-Custody Sudden Death



--- Mean rate of in-custody sudden deaths in pre-deployment period = 0.93/100,000 arrests

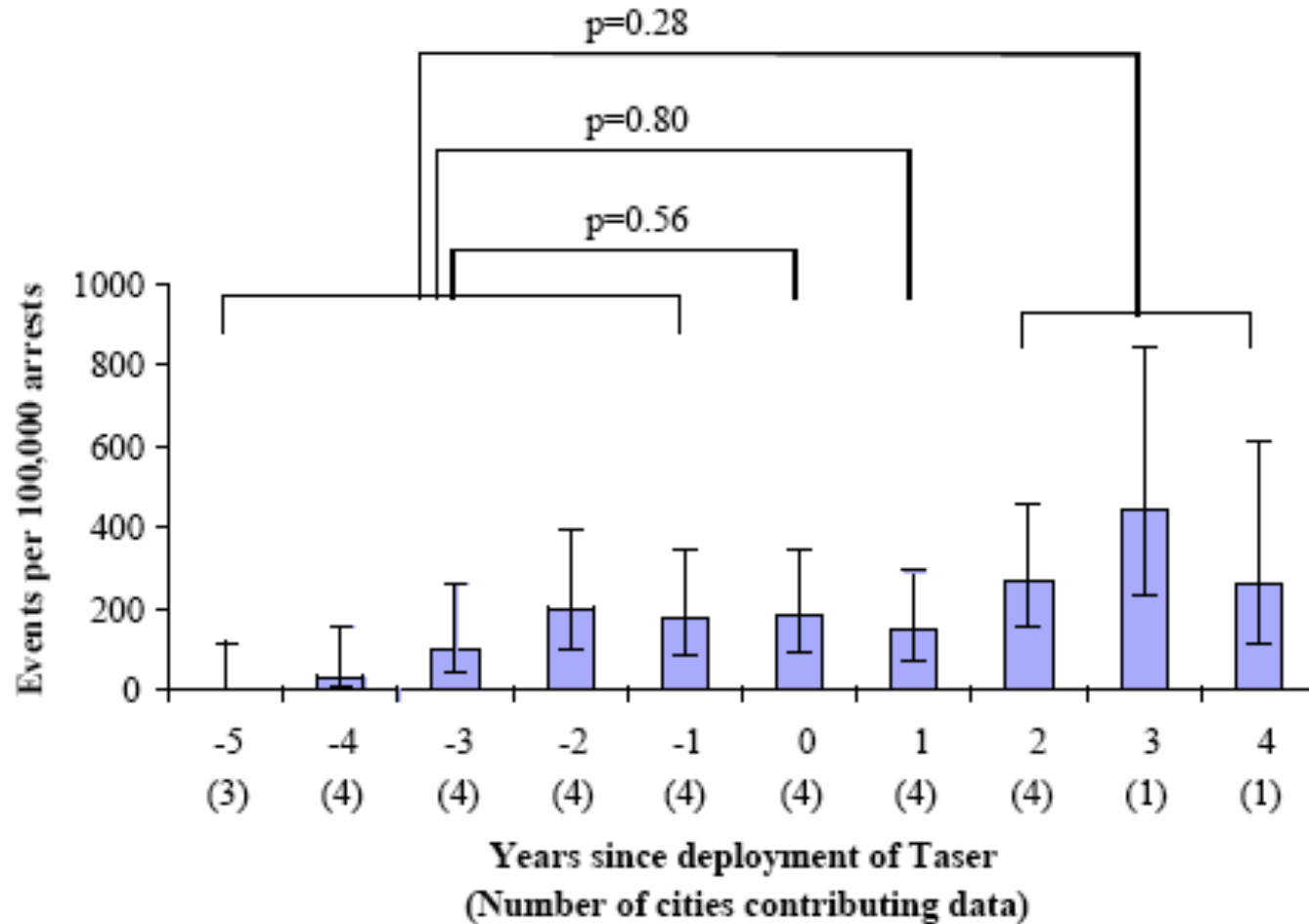
..... Mean rate of in-custody sudden deaths in post-deployment years 2 - 5 = 1.44/100,000 arrests

Rates of Lethal Force (Firearm) Deaths



--- Mean rate of lethal force deaths in pre-deployment period = 6.66/100,000 arrests
 Mean rate of lethal force deaths in post-deployment years 2 - 5 = 9.1/100,000 arrests

Rates of Officer Injuries



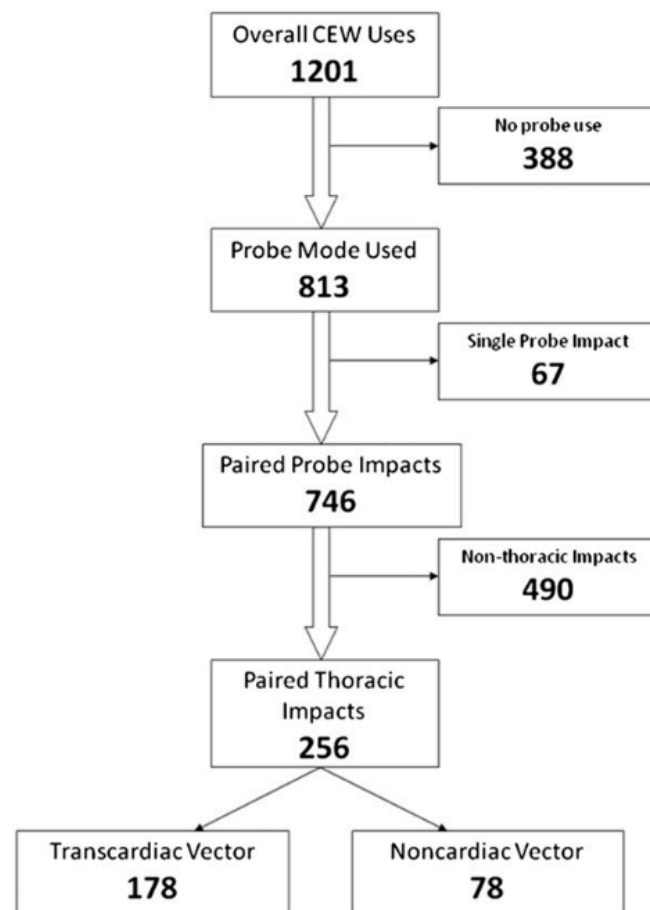
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- Insufficient statistical power to examine rare events (Taser-induced sudden deaths)
- If in-custody sudden deaths occur at a rate of 1-6/100,000 arrests, then a study in 178 suspects would have to be repeated **500x** before an fatal event might occur
- Confirms low absolute risk of cardiac arrest but does not prove safety



Funding source and author affiliation in TASER research are strongly associated with a conclusion of device safety

Peyman N. Azadani, MD, Zian H. Tseng, MD, Simon Ermakov, BA, Gregory M. Marcus, MD, and Byron K. Lee, MD
San Francisco, CA

American Heart Journal September 2011;162:533-7.

- 50 studies reviewed for funding source and conclusions
- 23 studies were affiliated or funded by TASER
- 27 independent studies
- A study with any TASER affiliation was 18 times more likely to conclude that the device is likely safe

Implications of Taser Research

- Rare events: low absolute risk for sudden death, but not non-lethal
- Vector across heart important for cardiac arrest risk but indirect/late health risks independent of vector
- Dart-to-heart distance important for cardiac arrest risk, therefore should be avoided in thin or small-frame persons, children
- Taser use is associated with significant early increase in sudden death rates
- Number of discharges increases risk of cardiac arrest and indirect/late health effects

Recommendations for Taser Use

- Tasers may serve a useful role in law enforcement, but policy should be designed taking into account the risks of sudden death and indirect/late health effects
 - Goal to avoid initial spike in in-custody sudden deaths, but rate will still be higher than before Tasers
- Tasers should be considered a potentially lethal weapon
- Tasers should only be deployed for situations in which subjects are in imminent threat of significant, potentially lethal harm to self or others
- Trainers and other policy consultants should be independent of Taser Inc.

Recommendations for Taser Use

- Avoid vector across chest if possible
- Avoid use in thin persons, children, pregnant women
- Avoid repeated shocks if possible
- AEDs should be mandated to allow for rapid resuscitation if cardiac arrest occurs
 - Side benefit: Police officers are often first responders to medical emergencies and research shows lives can be saved if police are trained in AED use
- Continuous observation for up to 6 hours for medical consequences of Taser
 - Immediate: cardiac arrest
 - Delayed: MI/“heart attack”, asthmatic attack, “excited delirium”, seizures
- Consider evaluation by EMS or MD, esp for higher risk persons:
 - Drug use, past cardiac history, diabetics, thin persons, shock across chest, repeated shocks

