FORCE SCIENCE® NEWS

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In This Edition:

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FSI investigates unintentional discharges: When are you at greatest risk?

I. FSI investigates unintentional discharges: When are you at greatest risk?

When are you most likely to experience the shock and potentially deadly consequences of an unintentional discharge:

a) While clearing an area in response to a call?

b) While performing routine firearms tasks, including cleaning your weapon?

c) While already engaged with a suspect in high-risk circumstances?

And where is this unwanted firing most likely to occur:

d) On the range?

e) In your department's parking lot or locker room?

f) At home?

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According to a new study by a research team from the Force Science Institute, the answers decisively are "b" and "e".

The good news, in the researchers' estimation, is that most unintentional discharges [UDs] could be eliminated by adhering to simple safety procedures.

Recommendations for reducing these dangerous mishaps are included in a report of the study's findings recently accepted by the peer-reviewed journal Applied Ergonomics. At this writing, publication date for the paper, titled "Toward a Taxonomy of the Unintentional Discharge of Firearms in Law Enforcement," is still pending.

FILLING THE KNOWLEDGE GAP. The FSI team consisted of staff behavioral scientists Dr. John O'Neill and Dr. Dawn O'Neill and executive director Dr. Bill Lewinski.

"UDs are a deadly threat to both officers and bystanders such as colleagues and civilians, yet they have been understudied in scientific literature," O'Neill writes, and the "paucity of research" has left a "critical gap between science and practice." His group's primary goal, he explains, was to identify the circumstances and officer behaviors that tend to be associated with UDs in hope that an analysis would result in "proactive strategies to prevent or minimize their occurrence."

The cooperation of law enforcement agencies for the study was solicited through Force Science News, and the researchers collected detailed "descriptive information" on 137 UD occurrences from a cross-section of departments within the United States.

The team parsed this total into 16 "discernable contexts" in which UDs occurred, 15 different behaviors officers were engaged in at the time of discharge, four general types of firearm involved (pistols, revolvers, shotguns, and rifles), four types of trigger action, and resulting injuries "ranging from flesh wounds to fatality."

A comprehensive breakdown is contained in the pending publication and provides a cautionary cataloging for officers and trainers alike by identifying the conditions under which UDs may be most likely. Here are some of the highlights:

DUTY STATUS/THREAT POTENTIAL. The researchers were able to confirm that over 70% of UDs occurred on duty.

By their assessment, over half "occurred in contexts with low threat potential"; that is, locations/situations "that did not involve response to a call" and where there was little "potential for encountering a threat during the incident."

Roughly another one-fourth took place during a call and were rated as having an "elevated threat potential," while about one-sixth occurred under a "high threat potential" where the involved officer was already engaged with a suspect or likely to become so. (For the rest, the source material was insufficient to assign a threat potential.)

Within these categories, the researchers documented these findings:

Low threat potential: In this group, UDs most often occurred on a firing range (22%), in departmental parking lots (20%), in a locker room (17%), or at an officer's residence (10%).

Elevated threat potential: Most of these happened while the involved officer was clearing an area (over 65%) or at the end of a call (19%).

High threat potential: Here, UDs most frequently took place while the officer was conducting a felony traffic stop (29%), searching for an armed suspect (29%), providing cover (14%), or using physical restraint (nearly 10%).

OFFICER BEHAVIORS. When UDs occurred, the involved officers were engaged in some "routine firearm manipulation" 60% of the time. To a much lesser extent, they were performing a physical activity that produced an unexpected muscle reaction responsible for their firearm discharging (24%) or conducting "unfamiliar tasks" (11%).

Within these categories, specifics include:

Routine manipulation: UDs most often occurred when officers were clearing a weapon, accounting for about one-third of the incidents in this category. Other relevant manipulations included storing/moving the weapon (about 23%), holstering/unholstering (17%), conducting function checks (16%), and performing maintenance (10%).

Muscle reaction: This, O'Neill explains, involves "using any part of the body to climb, jump, kick, punch, pull, push, run, squeeze, or otherwise engage in an activity unrelated to the firearm's trigger" but that provokes an involuntary reactive contraction of muscles in the finger that happens to be positioned on the trigger.

Specifically, this "muscle co-activation" resulted from an officer using another finger (to activate a frame-mounted flashlight or laser, for example) (36%), losing and trying to recover a grip on the firearm (21%), using a leg to jump or kick (18%), or losing balance (15%).

(Findings by other researchers regarding this phenomenon are covered in some detail in O'Neill's paper.)

Unfamiliar tasks: UDs in this category occurred when officers were switching a gun from one hand to another (40%), handling unfamiliar firearms (33%), or dealing with unfamiliar holsters or belts (27%).

INJURIES. Most documentation submitted to the researchers did not specify whether injuries occurred as a result of the UD. However, about 15% did acknowledge injury, all involving officers, and there was one fatality.

GETTING SAFER. The system for categorizing UDs that the research team developed allows for the pinpointing of problem locations and behaviors, which can then be addressed with enhanced training and procedural discipline, Lewinski told Force Science News.

Overall, the researchers estimate, a high percentage of UDs could be prevented. Among their suggestions for minimizing their occurrence:

• Observe the fundamentals of safe firearms handling: Always consider every gun to be loaded and index your trigger finger along the slide or frame, outside the trigger guard, until you intend to shoot. Include practice

with your non-dominant hand and with new or unfamiliar equipment.

• Before dry-firing or disassembling a firearm, verify there is no ammunition in the chamber. "If not already in practice, trainers are encouraged to consider crucial clearing steps in firearms disassembly that officers must perform in order to pass training, such as ejecting the magazine, racking the slide, and visually inspecting the chamber," O'Neill writes.

• Reinforce safe habits "to fluency with speed and accuracy" through dynamic training scenarios. As O'Neill explains, "Officers may be able to perform a skill on the range in a static position and under low-stress conditions, but the same skill may not [automatically] generalize in other contexts involving dynamic movements and higher physiological arousal." Reality-based training should include "scenarios designed to elicit muscle co-activation."

• In the absence of training to fluency, anticipate a possible uptick in UDs as officers transition to the new standard-issue weapons.

• Mandating the reporting of all UDs, but with retraining substituted for punishment like days off or termination, may result in a more comprehensive picture of such incidents, which, in turn, will better "inform policies and procedures" for safe firearms operation.

• The research team encourages trainers to "compare and contrast" the study's findings with "UDs that have occurred within their own agency," to tailor extra emphasis on "idiosyncratic" risks. "It is crucial that [agencies] continue to analyze the contexts, officer behavior, and firearm designs that contribute to UDs in order to inform qualification training, remediation/re-qualification training, policies, and procedures," O'Neill writes.

Last month, the authors presented key findings of the study at the 7th International Conference on Applied Human Factors and Ergonomics in Orlando, FL. Next month, they're scheduled for an oral presentation at the annual meeting of the Society for Police and Criminal Psychology in Austin, TX.

Meanwhile, O'Neill's team would like to expand its database on UDs on a continuing basis, with an eye to further researching this vital subject. If your department is willing to share UD information on a confidential basis, please email O'Neill at john.oneill@forcescience.org or call FSI headquarters at 507-387-1290 and leave your contact information.

Currently, the research team is developing a standardized form that agencies can use to collect important UD data for their internal use and for outside reporting purposes when appropriate. We'll let you know when this form is available.

When published, the title of the team's study will be "Toward a Taxonomy of the Unintentional Discharge of Firearms in Law Enforcement."

II. New study explores risk of death from CEW-induced falls

A new study of fatalities associated with controlled electrical weapons (CEWs) finds that falls producing traumatic brain injury are by far the greatest mortality risk to

suspects from these control devices. But even that risk is miniscule.

Out of some 3,000,000 field uses, a research team could document only 16 cases in which fatal brain injuries resulted from uncontrolled falling after CEW deployment. That's one in every 187,500 applications--"a real risk of death" but "small," the researchers note.

Compared to subjects who die from other arrest-related causes, those who are killed by falls tend to be significantly older, with those sustaining probe shots to the back possibly most vulnerable, the researchers found.

Although "an uncontrolled fall to the ground typically occurs with a sufficient probe spread, fatal falls from CEW deployment "are rare," the study concludes, "but they are critically important to understanding the risks of using such weapons." And some falls, the researchers point out, may be preventable.

The research, believed to be the first of its kind, was led by Dr. Mark Kroll, an adjunct professor of biomedical engineering at the University of Minnesota and the California Polytechnical Institute and a member of TASER International's scientific advisory board. His team included an expert in legal medicine and death from blunt trauma and falls, a forensic pathologist, and a CJ professor with a law enforcement background.

DEATH TOLL. To find relevant cases, the group screened two thoroughly maintained databases of arrest-related and post-confinement deaths, looking for incidents in which:

• subjects fell during an arrest or in-custody encounter

• the fall was "forced" by a CEW, and

• traumatic brain injury from the fall "contributed to or caused" the resulting fatality.

Out of 1,030 incidents in which circumstances included a CEW discharge, they isolated only 16 deaths that fit their criteria (plus one other in which the cause of death was a cervical spinal fracture), after reviewing autopsy and police reports, litigation filings, death certificates, and/or news accounts. Each is described with salient detail in the study. All but one were males.

FALLING CONTEXT. The cases include falls in which subjects, often intoxicated, hit their head on concrete steps, on the ground, on the floor, on a sidewalk, on pavement, on a curb, on a driveway, on a light pole, and on a concrete porch.

Three fell from an elevated position: one from a second-floor ledge, one from a roof, and one while climbing over a high wall. Five subjects were "moving rapidly" when they fell; riding a bicycle or running. Three were walking, eight standing or climbing.

The study includes stick-figure illustrations of the various types of falls that occurred and the velocity of head impact generated, from a crumpling to the knees to a rigid, full-body pitch. "Forward falls have lower risks of life-threatening injuries compared to backward falls," Kroll writes.

In almost all cases, death occurred after some delay and usually in a hospital, in one

case after the subject remained in a coma for 725 days.

IMPORTANT TAKE-AWAYS. From their findings, Kroll's team offers several practical take-aways for trainers and patrol officers:

• The average age of those killed was 46, "significantly greater than the age of the typical" arrest-related decedent, suggesting an enhanced vulnerability for falling in older subjects. "The mortality risk from head injury increases with age," the study notes.

• The researchers were able to identify the CEW probe locations in 14 of the 16 brain-damaged subjects. In nine cases (64%), they were in the back, "suggesting a possibly increased mortality risk with probe deployments" to that part of the body.

• Perhaps most important, the study calls attention to warnings from TASER International, the largest CEW manufacturer. Kroll writes: "They warn against use on elevated subjects [and against] running or bicycling subjects....

"With hindsight, one could say that strictly following these warnings could have prevented 8 of the 16 fatalities, which is \0xBD of the cases." He concedes, however, that this is "utopian reasoning," in that involved officers may not have had a "viable control alternative."

RELATIVE RISK. In an email to Force Science News, Kroll put the risk of CEW-induced falling in statistical perspective.

"Fatal head injury [from such a fall] is an exceedingly unusual event," he writes, "and the study demonstrates that 99.9994% of electronic control incidents do not result in fatal brain injury.

"Electronic weapons continue to be the most studied law enforcement force option and there is no study that has found that other force options are less injurious. Control [alternatives] such as baton strikes, physical grounding, and tackling likely have higher rates of fatal brain injury."

What Kroll calls "unscientific smoke" from the media and plaintiffs' attorneys has focused on the alleged risk of electrocution by CEWs. But the slim risk of death by traumatic brain injury from falling "far exceeds [even] the theoretical risk of electrocution, which has been estimated at about 1 in 3,000,000," he writes.

"It certainly exceeds the demonstrated risk of electrocution, as there has yet to be an actual documented case."

Click here for a free abstract of this study, "Fatal traumatic brain injury with electrical weapon falls," published in the Journal of Forensic & Legal Medicine. At this site you can also link to a full paper for a fee.

Dr. Kroll can be reached at: mark@kroll.name

III. Hearing loss & gunfight survivability

Could hearing loss, perhaps from military combat or range exposure, affect your ability to survive a gunfight?

From the new book Grunt: The Curious Science of Humans at War by Mary Roach:

"[A] team of researchers with Walter Reed's National Audiology and Speech

Center...have been documenting the effects of hearing loss on lethality and survivability....

"Members of the 101st Airborne Division agreed to wear special helmets rigged with hearing loss simulators. Among the top-performing teams, even mild hearing loss caused a 50% decrease in 'kill ratio' (the number of enemies eliminated divided by the number of surviving teammates). Not so much because their difficulty hearing was causing them to shoot or run in the wrong direction, but because they were unsure of what was going on. With their ability to communicate compromised, their actions were more tentative."

Our thanks to John Fairbairn, co-founder of SSI Technology in Northfield, IL, for bringing this intriguing book to our attention.

Written by Force Science Institute
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