



NATIONAL OCCUPATIONAL RESEARCH AGENDA (NORA)

National Occupational Research Agenda for Public Safety

DRAFT: DO NOT COPY OR CITE TEXT

March 2018

Developed by the NORA Public Safety Council

For more information about the National Occupational Research Agenda (NORA), visit the web site:
<https://www.cdc.gov/niosh/nora/>

For monthly updates on NORA, subscribe to NIOSH eNews at www.cdc.gov/niosh/eNews

Disclaimer

This information is distributed solely for the purpose of pre-dissemination stakeholder review under applicable information quality guidelines. This is a product of the National Occupational Research Agenda (NORA) Public Safety Sector Council. It does not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

INTRODUCTION

What is the National Occupational Research Agenda?

The National Occupational Research Agenda (NORA) is a partnership program to stimulate innovative research and workplace interventions. In combination with other initiatives, the products of this program will reduce the occurrence of injuries and illnesses at work. Unveiled in 1996, NORA has become a research framework for the Nation and the National Institute for Occupational Safety and Health (NIOSH). Diverse parties collaborate to identify the most critical issues in workplace safety and health and develop research objectives for addressing those needs.

NORA enters its third decade in 2016 with an enhanced structure. The ten sectors formed for the second decade continue to prioritize occupational safety and health research by major areas of the U.S. economy. In addition, there are seven cross-sectors organized according to the major health and safety issues affecting the U.S. working population. While NIOSH is serving as the steward to move this effort forward, it is truly a national effort. NORA is carried out through multi-stakeholder councils, which are developing and implementing research agendas for the occupational safety and health community over the decade (2016-2026). Councils address objectives through information exchange, partnership building, and enhanced dissemination and implementation of evidence-based solutions.

NORA groups industries into ten sectors using North American Industry Classification System (NAICS) codes. The Public Safety Sector encompasses NAICS code groupings 92212, 92214, 92216, 115310 and 62191. Public safety workers are employed in some of the most dangerous occupations in the world. Public Safety has five sub-sectors: fire service, law enforcement, corrections, emergency medical service (EMS), and wildland fire service. Every day across the nation, emergencies occur that threaten people's life, well-being, property, peace, and security. During these events, society relies on public safety workers to respond, protect, and restore the safety, security, and routine to our lives. Every time these responders take action, they may be putting their health, safety, and even lives on the line.

What are NORA Councils?

A NORA Council supports each NORA sector and cross-sector. Participation in NORA Councils is broad, including stakeholders from academic institutions, large and small businesses, professional societies, government agencies, and worker organizations. Councils are co-chaired by one NIOSH representative and one member from outside of NIOSH.

Statement of Purpose

NORA councils are a national venue for individuals and organizations with common interests in occupational safety and health topics to come together. Councils have started the third decade by identifying broad occupational safety and health research objectives for the nation. These research objectives build from advances in knowledge in the last decade, address emerging issues, and are based on council member and public input. Councils will spend the remainder of the decade working together to address the agenda through information exchange, collaboration, and enhanced dissemination and implementation of solutions that work.

Although NIOSH is the steward of NORA, it is just one of many partners that make NORA possible. Councils are not an opportunity to give consensus advice to NIOSH, but instead a way to maximize resources towards improved occupational safety and health nationwide. Councils are platforms that help build close partnerships among members and broader collaborations between councils and other organizations. The resulting information sharing and leveraging efforts promotes widespread adoption of improved workplace practices based on research results.

Councils are diverse and dynamic, and are open to anyone with an interest in occupational safety and health. Members benefit by hearing about cutting-edge research findings, learning about evidence-based ways to improve safety and health efforts in their organization, and forming new partnerships. In turn, members share their knowledge and experiences with others and reciprocate partnerships.

Public Safety Sector Council

At the start of the second decade of NORA, Public Safety was considered a sub-sector of the NORA Services sector. However, the issues affecting public safety workers soon proved unique enough to make Public Safety a full sector. The NORA Public Safety Sector Council was convened on November 15, 2006 and held additional meetings in May and December 2007. The Council examined summaries of the stakeholder input that had been received during NORA Town Hall meetings between December 2005 and December 2006 and the comments that were submitted through the NIOSH website during the same period. Occupational safety and health surveillance data for public safety workers were reviewed and summarized on the Public Safety Sector website. Significant gaps exist in data for all occupational injuries and illnesses among public safety workers.

The industry experts, labor representatives, academic investigators and public health practitioners that make up the NORA Public Safety Council identified research and intervention goals for the five public safety sub sectors, and finalized the goals in March 2009. In April 2009, the Public Safety Council developed and released the NORA National Public Safety Sector Agenda which included strategic research goals for the Nation. This document and its strategic research goals were updated and published as a revised agenda in 2013. In 2015, as the second decade of NORA was coming to a close, the council reviewed the second decade agenda and accomplishments and the current occupational burden data.

The Public Safety Council includes representatives from public safety and emergency responder agencies, professional associations, labor unions, research organizations, academia, and government agencies. The NIOSH Public Safety Program manager, two coordinators, and one assistant coordinator also participate and facilitate the work of the Council.

What does the National Occupational Research Agenda for Public Safety represent?

The National Occupational Research Agenda for Public Safety is intended to identify the knowledge and actions most urgently needed to identify occupational risk factors to prevent avoidable adverse health outcomes among workers. This Agenda provides a vehicle for all stakeholders to describe the most relevant issues, research gaps, and safety and health needs for the sector. It is meant to be broader than any one agency or organization. It identifies the priorities for the entire country and all of its research and development entities, whether government, higher education, or industry. Because the Agenda is intended to guide national occupational health and safety efforts for the Public Safety sector, it cannot at the same time be an inventory of all issues worthy of attention. The omission of a topic does not mean that topic was viewed as unimportant. Those who developed

this Agenda did, however, believe that the number of topics should be small enough so that resources could be focused on a manageable set of objectives, thereby increasing the likelihood of real impact in the workplace.

NIOSH has used the draft Agendas created by the sector and cross-sector NORA Councils to develop a NIOSH Strategic Plan for fiscal years 2019-2023. Programs will use the [burden, need and impact method](#) (BNI Method) to develop research goals that articulate and operationalize the components of the NORA Sector and Cross-Sector Agendas that NIOSH will take up. NORA Agendas and the NIOSH Strategic Plan are separate but linked.

Who are the target audiences?

This agenda is used by public safety stakeholders in the U.S. to identify priority research projects and programs to improve worker health and safety. Public safety stakeholders include local, state and federal organizations; management and labor associations; research institutions including academia and centers; and NIOSH intramural and extramural partners.

How was the research agenda developed?

In 2015, as the second decade of NORA was coming to a close, the Council reviewed the second decade agenda and accomplishments and the current occupational burden data. The Council underwent a systematic process to identify the objectives for the third decade of NORA including: 1) reviewing multiple Public Safety sector documents to assess the burden of current occupational hazards on the public safety workforce, 2) assessing the current investment in burden areas, and 3) comparing national research investments across the public safety workforce.

THE OBJECTIVES

Objective 1: Reduce cardiovascular disease, cancer, and other chronic diseases

Public safety workers are expected to engage in response efforts, often during and after traumatic events, and while the work may be personally rewarding, it is also challenging and has the potential to affect public safety workers in harmful ways. One of the greatest threats to public safety workers' health is the stress they may encounter as a result of their occupation. Often, stress experienced by public safety workers is addressed as an afterthought, or not at all. If not addressed properly, stress may affect worker's emotions, behaviors, mental, and physical health. In some cases, a stressful work environment may play an important role in increasing public safety workers risk for illnesses such as heart disease, hypertension, and diabetes [APA 2017].

Cardiovascular disease (CVD) is an occupational health concern among all public safety workers. Over the past decade, CVD has accounted for over half (51%) of all fire fighter on-duty fatalities [USFA 2017]. Overall, NIOSH burden data show that the attributable fraction for coronary heart disease among workers in the Public Safety sector is 13% to 31% [Groenewold et. al 2017]. Also, cardiac strain during emergency response operations can increase risk of sudden cardiac death. Data has also indicated that 7-22% of on-duty deaths among police officers, 17% among wildland fire fighters, and 11% of emergency medical service workers are due to sudden cardiac events [Butler et al. 2017; Zimmerman 2012; Maguire et al. 2002; Tridata Corporation 2002]. Acute physiological changes in the human body, including thermal and cardiac strain, may occur during emergency response operations and can increase the risk of sudden cardiac death. Physiological changes are especially likely during alarming situations (e.g., fire suppression, suspect restraints, altercations, or vehicular pursuits) [OJP Diagnostics Center 2013; Varvarigou et al. 2014].

Researchers are beginning to document that exposure to particulates and other contaminants, heavy physical exertion, underlying risk factors, and excess cardiovascular strain may also increase public safety worker's risk for sudden cardiac events [Gledhill and Jamnik 1992, Farioli et.al 2014, NIOSH 2007]. While much focus is on the emergency incident, there still is a gap in understanding the role of the period immediately before and after (24 - 48 hours) the emergency event or training event, or the strenuous work conducted at those events. While fire fighters and EMS are trained in recognizing signs and symptoms of cardiovascular health issues of others, they often are ignored in regard to their own personal health. Many times there is no pain after a strenuous event, only the more general sense of "not feeling well". This symptom often is regarded as just being exhausted from the event. The Public Safety Officers' Benefits program adjusted its regulations to those deaths that occur during the 24 hour period after a strenuous event as part of the Hometown Heroes Survivors Benefits Act of 2003. However, many public safety workers are not trained in understanding how the physiological stresses of emergency response activities can impact their bodies and for how long these physiological stressors/changes remain in their bodies [IAFF 2017].

Recent studies have also demonstrated an association between public safety work and other chronic diseases. Most recently, NIOSH researchers demonstrated that there is a correlation between firefighting and certain types of cancer [Daniels et al. 2014]. Little is known about cancer and other chronic disease risks among other workers in the public safety sector, despite their potential for exposures to a variety of carcinogenic agents, lifestyles, or risk factors that may increase their risk for cancer and other illnesses.

The NORA Public Safety Council encourages research focused on these topics in order to develop better emergency responder work hazard exposure controls, work practices and operating procedures to reduce the incidence cancers, respiratory, and CVD for public safety workers.

- Identify exposures experienced by fire service and wildland fire fighters during suppression and overhaul/mop-up operations (including dermal, sensory, respiratory exposures)
- Develop technological approaches to provide or improve respiratory and thermal protection for fire fighters during suppression and overhaul operations
- Recommend practices for the prevention of exposure, including exposures to carcinogenic and other hazardous compounds from use and storage of contaminated personal protective equipment, and also diesel exhaust
- Investigate and develop improved and cost efficient technologies for the detection of contaminants, such as personal direct reading devices that may be present during firefighting and emergency response operations
- Identify impacts of non-occupational risk factors on public safety sector employees

Objective 2: Reduce infectious disease transmission

Public safety workers can be exposed to airborne and vector-borne infectious diseases and blood and bodily fluid disease causing pathogens in performing their duties. These regularly include tuberculosis (TB), human immunodeficiency virus (HIV), Hepatitis B and C, influenza, Lyme disease and Methicillin-resistant *Staphylococcus aureus* (MRSA), with the additional potential to involve emerging or epidemic threats such as but not limited to Ebola or Zika viruses. EMS and fire service workers who provide lifesaving medical support and other functions in unpredictable and uncontrolled environments and under adverse conditions may be at increased risk for exposures to these types of diseases. Corrections officers can be exposed to a variety of infectious agents when interacting with detainees and inmates. Infectious agents vary in their routes of transmission and can occur via contact with the skin, mucous membranes such as the eyes and nose, or inhalation. Not wearing appropriate personal protective equipment (PPE) such as respiratory protection, eye/face protection, gloves and gowns can increase the risk of exposures [Wirth et al 2013]. While many of these illnesses are, in theory, preventable, more information on the exposure to and incidence of these illnesses among public safety workers is needed to develop effective practices for preventing, recognizing and treating such diseases.

The NORA Public Safety Council encourages research focused on these topics in order to develop better emergency responder work hazard exposure controls, work practices and operating procedures to reduce the incidence infectious diseases for public safety workers.

- Assess exposures to and incidence of airborne and vector borne infectious diseases for public safety workers
- Develop effective practices for preventing, recognizing and treating infectious diseases

Objective 3: Reduce musculoskeletal disorders

While public safety workers face a variety of hazards and exposures as they perform their job, the most commonly reported work-related injuries are often musculoskeletal disorders (MSDs). MSDs are soft-tissue injuries caused

by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions. The strenuous physical demands of the job and limited modified work opportunities suggest that MSDs are potentially disruptive and costly to public safety workers. Emergency medical technicians and paramedics reported the highest incidence work-related of MSDs (184 per 10,000 full-time workers). This is more than five times the national average of 34 per 10,000 full-time workers [BLS 2016a]. The Bureau of Labor Statistics (BLS) data also indicated fire fighters reported an MSD rate of 179 per 10,000 full-time workers (also more than five times the national average), and police and sheriff patrol officers reported an MSD rate of 91 per 10,000 full-time workers (more than double the national average)[BLS 2016a].

Table 1: Number, incidence rate, and median days away from work for nonfatal occupational injuries and illnesses involving days away from work and musculoskeletal disorders by selected worker occupation and ownership, 2014. Adapted from U.S. Bureau of Labor Statistics Table 16.

Occupation	Reported Number of MSD	Incidence Rate (per 10,000 FTE)	Median Days Away from Work
Total	365,580	34	13
Fire Fighters	5,760	179	15
Police and Sheriff Patrol Officers	5,180	91	27
Emergency Medical Technicians and Paramedics	3,880	184	12
Correctional Officers and Jailers	2,850	75	24
Wildland Fire	No information provided from BLS	No information provided from BLS	No information provided from BLS

To better understand nonfatal injuries and illnesses among EMS workers, another data source was used. The occupational supplement to the National Electronic Injury Surveillance System [[NEISS-Work](#)] is a national probability-based sample of U.S. hospital emergency departments. Based on this 2014 data, there were an estimated 21,300 injuries and illnesses among EMS workers that were treated in U.S. hospital emergency departments. This data indicated that sprains and strains were the most common type of injury among EMS workers, with 7,100 sprains and strains accounting for 34% of all injuries. Most of the injuries reported affected the upper and lower trunk, hands, and fingers. The greatest portion of injuries or illnesses involved overexertion and bodily reaction (35%). About half of the overexertion and bodily reaction events were specifically identified as overexertion during lifting [NIOSH 2016].

The NORA Public Safety Council encourages research in support of reducing the impact of MSDs for public safety workers in these areas:

- Evaluate the impact and effectiveness of targeted prevention, fitness, and wellness interventions on the reduction of MSD number and severity
- Evaluate the impact of occupational task movement assessment and training on elimination of movements patterns that could contribute to MSDs
- Identify stressors that lead to MSDs as well as wellness and fitness, and proper body movement training in public safety occupational work
- Develop new procedures or strategies to prevent MSD related injuries, especially back, shoulders, knee, ankle/foot

- Assess the economic impact of MSDs in the Public Safety sector
- Evaluate the use of new technology to reduce onset/prevalence of MSDs

Objective 4: Reduce motor vehicle injuries

Motor vehicle crashes (MVCs) are the leading cause of all workplace fatality occupational injuries in the United States [BLS 2016b]. In 2015 MVCs accounted for 37% of all fatal occupational injuries, and most of these (70%) occurred when the decedent was driving or riding in a vehicle [BLS 2016c]. When specifically looking at public safety workers, MVCs were also the leading cause of fatal traumatic injuries, accounting for 44% of all fatalities [BLS 2016d]. Most of the incidents were due to collisions with other vehicles while the decedent was a vehicle occupant, but 25% occurred when a public safety worker was struck by another vehicle when working outside the vehicle or was a pedestrian [BLS 2016d]. Traffic related fatalities were the leading cause of law enforcement officer (LEOs) deaths in 2017 [NLEOMF 2017].

The National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS) system contains detailed information on the fatal crashes that involved LEOs. These data show that more than half of the passenger vehicle crashes resulting in LEO fatalities were crashes with a motor vehicle in transport (56%), followed by crashes with fixed objects (33%); rollovers and other crash mechanisms accounted for 11% of fatal crashes [NHTSA 2011]. Passenger vehicle crashes with LEO fatalities occurred more frequently during dark hours (8 PM to 4:59 AM), whereas the fatal crashes with LEOs on motorcycles were most common between noon and 3:59 PM. Adverse weather conditions were a factor in 12% of fatal LEO crashes. Of the LEOs killed in passenger vehicle crashes, nearly half used seat belts and nearly all wore motorcycle helmets (44% of motor vehicle occupants wore seat belts; 91% of motorcycle riders wore helmets) [NHTSA 2011].

When responding to structural fires or medical emergencies, fire fighters are at increased risk for roadway collisions with other motor vehicles when navigating through traffic and intersections. Death in road vehicle crashes was the second most frequent cause of on-duty fire fighter fatalities in 2016 [NFPA 2017]. Furthermore there was an estimated 16,600 fatal and non-fatal collisions involving fire department emergency vehicles where departments were responding to or returning from incidents, the highest number since data collection efforts began in 1990 [Haynes and Molis 2016]. A report from the Federal Emergency Management Agency (FEMA) that reviewed fire fighter vehicle incidents from 1996 to 2012, indicated that the majority of nonfatal incidents were the result of a collision with a civilian vehicle or a rollover of a fire service vehicle [FEMA 2014].

The public safety and emergency response community recognizes that motor vehicle crashes are an important and preventable cause of injury. Many of these motor vehicle-related fatalities of emergency responders could be prevented through measures such as appropriate seatbelt use, proper motor vehicle operation, use of high visibility clothing, and equipment or motor vehicle design changes [FEMA 2014]. The NORA Public Safety Council encourages research in support of reducing the incidence of fatal and nonfatal injuries related to motor vehicles in these circumstances:

- Determine factors impacting use of provided restraints in vehicles by public safety workers
- Evaluate efficacy of safety belt alarm devices in increasing safety belt use by public safety workers
- Identify potential for connected and autonomous vehicle technology to reduce public safety vehicle crashes

- Determine factors contributing to excessive speeding and other traffic violations that contribute to motor vehicle accidents for public safety workers
- Identify technology and best practices to avoid being struck by vehicles while working on roadways
- Determine the impact of shift length as a fatigue factor relating to driving and injury
- Determine the incidents of vehicular related injury and death for correctional officers
- Estimate the cost of MVC injuries
- Determine risk factors contributing to motor vehicle accidents when responding at high speeds with lights and siren which is nationally identified as a “Code 3” emergency response.

Objective 5: Reduce workplace violence

Workplace violence is a leading cause of injury and death among workers in public safety. Among correctional officers, data have indicated that assaults account for 40% of all fatal workplace injuries and 38% of nonfatal workplace injuries [Konda et al. 2012]. Among LEOs, physical assaults accounted for 40% of duty-related fatalities in the last decade according to the National Law Enforcement Officers Memorial Fund [NLEOMF 2017]. When focusing on nonfatal occupational injuries, another data source indicated that 27% of LEOs sought treatment at an emergency department for on-duty injuries due an assault or violent encounter [Tiesman et al. 2017].

While just 8% of EMS occupational fatalities have been attributed to assaults and violent acts [Maguire et.al 2013], 67% of nationally registered EMS providers reported experiencing verbal violence and 44% reported experiencing physical violence within a one year period [Reichard et al. 2016]. While assaults are not necessarily a leading cause of injury or death for fire fighters, recent surveys have suggested that violence may be more widespread than previously thought as fire departments are responding to more emergency medical calls, and similar to the EMS providers, this may result in increased verbal and physical violence [Dean 2016; Haynes and Stein 2017].

Recent research has also suggested that many EMS, LEOs, and fire fighters are required to respond to calls that involve patients under the influence of alcohol or drugs (e.g., opioids), violent patients, or patients with weapons [Oliver and Levine 2015; Taylor et al. 2015]. Research is needed to better understand how to protect these workers, as they are required to respond to these emergency situations that may increase public safety workers risk for being involved in a potentially violent situation.

The NORA Public Safety Council encourages research to reduce the incidence of fatal and non-fatal injuries related to workplace violence in these circumstances:

- Better quantify assault and violent encounters and civil disturbances for LEOs
- Evaluate patient assault and bystander violence for EMS and fire fighters
- Identify the incidence and impact of violent encounters during daily interactions for corrections officers
- Assess incidences of potential drug associated violence impacting public safety workers
- Determine best practices and develop training protocols to differentiate between patient/perpetrator organic or drug/alcohol induced altered mental status to reduce incidences of assaults and violence to law enforcement, EMS and fire service personnel.

Objective 6: Promote healthy work design and well-being

Traditional occupational safety and health protection programs have primarily focused on ensuring that work is safe and that workers are protected from the harms that arise from work itself. While this is important, it is also important to recognize how the physical and psychosocial work environment and the organization of work can be a social determinant of worker's health. For public safety workers, many work-organizational and environmental factors can impact health, such as the stressful work environment that is often inherent with the type of work performed (emergency response); shift work and long work hour requirements; intense physical demand and physical fitness requirements; and the potential for long term exposure to chemicals and infectious diseases. In addition, public safety workers may experience or witness violence, trauma, death, or loss during their career. Exposure to these events, as well as other work organization factors may lead to poor mental and emotional health. Depression, post-traumatic stress disorder, and other mental health issues are starting to become more prevalent among this workforce [Rutkow et al 2011]. Comprehensive approaches, taking into consideration the work environment, work organization, and behavioral/personal risk factors are needed to promote worker health and well-being.

To protect and advance public worker safety, health, and well-being it is important to consider the design of work, management practices, and the work environment in which they operate in.

The NORA Public Safety Council encourages research in the following category in order to improve mental health and well-being

- Discover the best methods to identify, prevent and treat mental or behavioral health problems before they evolve in to PTSD, depression, alcoholism or drug use for public safety sector employees
- Identify effective interventions to reduce the risk of suicide among public safety workers and conduct "suicide survivor" interventions and counseling for co-workers and departments
- Identify if there is an increased risk of suicide among public safety sector workers as compared to the general population
- For each of the five sub-sectors (fire service, law enforcement, corrections, EMS, and wildland fire service), identify the impact of repeated exposure to traumatic events with potential for adverse mental or emotional distress on the mental health of workers
- Determine the most effective post-incident and longer term interventions for public safety sector employees following potentially traumatic events
- Determine the impact of new technology, including social media information and messaging to promote and encourage healthy work environments
- Determine the impact of social media information and messaging to document and share work conducted by public safety sector workers
- For specific disciplines within the public safety sector, identify work-life balance (work-family balance) issues, particularly in the transition between work and home life and the impact of mandatory overtime and understaffing on work-life balance
- Evaluate impacts of workplace stress, shiftwork, and other work organization factors
- Identify impacts of other risk non-occupational risk factors (hypertension, obesity, and smoking) on public safety sector employees

Objective 7: Improve surveillance

Public health surveillance is the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health. Timely and high quality surveillance data about public safety workers' injuries and illnesses establish baselines that are critical to characterizing and reacting to response events. While there are a variety of systems that are used by many different agencies to monitor, track and inform about public safety workers' occupational injuries and illnesses, there are still substantial gaps in our knowledge about non-fatal injury and illness rates among Public Safety workers.

The NORA Public Safety Council encourages research in support of improving public health surveillance for public safety workers in these areas:

- Develop methods to better quantify the prevalence of and risk factors for suicide in public safety sector employees
- Use routine medical monitoring and medical surveillance programs, establish a baseline and assess changes in health status throughout public safety workers' careers and after major responses
- Assess and provide recommendations to improve public safety workers' accident and injury reporting and the quality of surveillance data across federal agencies
- Evaluate current data collection systems' use and ability to inform about public safety workers' illnesses and injury
- Develop new data collection systems, including new technologies, to assist in data collection and simplify reporting
- Determine public safety workers' infectious disease exposure and accuracy of reporting using existing surveillance systems
- Collect and analyze data for discipline specific injuries, including MSDs and motor vehicle injuries
- Determine the incidence of on-duty preventable injury or illness for public safety workers

Objective 8: Improve resilience/preparedness

Every day across the nation, disruptions and emergencies occur that threaten lives, well-being, property, peace, and security. Public safety workers are relied upon to respond, protect, and restore safety, security, and routine to daily life. Every time these responders take action, they may be putting their health, safety and even their lives on the line. During responses to major natural disasters, outbreaks and terrorist attacks, the risk to their health and safety is particularly high. Pre-event preparation, training, and access to readily available information, field assessment, and safety equipment (including personal protective equipment) are critical to minimizing consequent deaths, injuries, and illnesses, and to promote overall workforce resilience. Once the event occurs the responders are then placed under a time-urgent, dual-cognitive demand where they must attend to the hazards (including attention to self and crew members' safety and health), and they must perform the work necessary to complete a rescue. Although the dangers can never be eliminated, much can be done to manage the risks involved and protect these workers [NIOSH 2015a].

While emergency preparedness has received focus in many fields, it is often taught as what to do when the unthinkable happens, or involve working an occasional collateral duty. The risks of exposure occurring only occasionally for some fields is often part of normal operations for public safety workers. Working 10-hour shifts

increases the risk for accidents and errors by 13%, while working 12-hour shifts increases the risk for accidents and errors by 28% [NIOSH 2014]. Outdoor workers are exposed to many types of hazards that depend on their type of work, geographic region, season, and duration of time they are outside [NIOSH 2015b]. The same preparedness techniques used by those who typically do not work outdoors and/or in hazardous environments may be provide additional protection from work place injury and illness for public safety workers who do normally operate in such conditions.

The NORA Public Safety Council encourages research in support of improving public safety workers knowledge, understanding and practice of preparedness with particular view to reducing workplace related injury and illness with focus on:

- Improve risk management for routine operations as well as emergency response environments, including shift duration and intensity
- Identify health benefits and risks associated with modifying the PPE worn and equipment used, including field/tactical first aid kits
- Assess the impact of resilience-building strategies on retention, disability claims, and early retirement rates (from healthy work design)

REFERENCES

- APA (American Psychological Association) [2016]. Stress effects on the body. Washington DC: American Psychological Association, <http://www.apa.org/helpcenter/stress-body.aspx>
- BLS [2016a]. Nonfatal occupational injuries and illnesses requiring days away from work, 2014. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, <http://www.bls.gov/news.release/pdf/osh2.pdf>
- BLS [2016b]. Table A-2. Fatal occupational injuries resulting from transportation incidents and homicides, all United States, 2014. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, <http://stats.bls.gov/iif/oshwc/cfoi/cftb0287.pdf>
- BLS [2016c]. TABLE A-2. Fatal occupational injuries resulting from transportation incidents and homicides, all United States, 2015. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, <https://www.bls.gov/iif/oshcfoi1.htm>, <https://www.bls.gov/iif/oshwc/cfoi/cftb0287.pdf>
- BLS [2016d]. Table A-6. Fatal occupational injuries resulting from transportation incidents and homicides by occupation, all United States, 2015. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, <https://www.bls.gov/iif/oshwc/cfoi/cftb0300.xlsx>.
- Butler C, Marsh S, Domitrovich JW, and Helmkamp J. [2017]. Wildland firefighter deaths in the United States: A comparison of existing surveillance systems. *JOEH* 14(4): 258-270.
- Daniels RD, Kubale TL, Yiin JH, Dahm MM, Hales TR, Baris D, Zahm SH, Beaumont JJ, Waters KM, Pinkerton L. [2014]. Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950-2009). *Occup Environ Med* 71(6):388-97
- Dean A [2016] Scene safety: violence against firefighters. *Fire Engineering* 40-46, <http://digital.fireengineering.com/fireengineering/201610?pg=46#pg46>
- Farioli A, Yang J, Teehan D, Baur DM, Smith DL, Kales SN [2014]. Duty-related risk of sudden cardiac death among young US firefighters. *Occup Med (Lond)* 64(6):428-35.
- FEMA [2014]. Emergency vehicle safety initiative. Washington, DC: U.S. Department of Homeland Security, Federal Emergency Management Agency, U.S. Fire Administration, https://www.usfa.fema.gov/downloads/pdf/publications/fa_336.pdf
- Gledhill N, Jamnik VK [1992]. Characterization of the physical demands of firefighting. *Can J Sport Sci* 17(3):207-213
- Groenewold M, Brown L, Smith E, Pana-Cryan R, Schnorr T [2017]. An estimate of the total number of incident occupational injuries and illnesses occurring in the United States in 2012 (Manuscript in preparation). National Institute for Occupational Safety and Health, Cincinnati, OH.
- Haynes H, Molis J. [2016]. U.S. Firefighter Injuries – 2015 Quincy, MA: National Fire Protection Association, Publication no FF110, <http://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/the-fire-service/fatalities-and-injuries/firefighter-injuries-in-the-united-states>

Haynes H, Stein G [2017]. U.S. Fire Department Profile – 2015. Quincy, MA: National Fire Protection Association, <http://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/the-fire-service/administration/us-fire-department-profile>

IAFF [2017]. Email message from Larry Petrick, Deputy Director, Department of Occupational Health and Safety, International Association of Fire Fighters, to William Haskell, NIOSH Public Safety Program Co-Coordinator, March 29.

Konda S, Reichard AA, Tiesman HM [2012]. Occupational injuries among US correctional officers, 1999-2008. *J Saf Res* 43(3):181-6.

Maguire BJ, Hunting KL, Smith GS, Levick NR. [2002]. Occupational fatalities in emergency medical services: a hidden crisis. *Ann Emerg Med* 40:625-632.

Maguire BJ, Smith S [2013]. Injuries and fatalities among emergency medical technicians and paramedics in the United States. *Prehosp Disaster Med* 28(4):376–382.

NFPA (National Fire Protection Association) [2017]. Statistics about the fire service, The United States Fire Service Fact Sheet. Quincy, MA: National Fire Protection Association, <http://www.nfpa.org/News-and-Research/Fire-statistics-and-reports/Fire-statistics/The-fire-service>

NHTSA [2011]. Characteristics of law enforcement officers' fatalities in motor vehicle crashes. *Ann Emerg Med*. 58(6):568.

NIOSH [2016] Emergency medical service worker injury and illness data. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, <http://www.cdc.gov/niosh/topics/ems/data.html>

NIOSH [2015a]. Emergency Response Resources. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, <https://www.cdc.gov/niosh/topics/emres/flood.html>

NIOSH [2015b]. Hazards to outdoor workers. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, <https://www.cdc.gov/niosh/topics/outdoor/>

NIOSH [2014]. Interim NIOSH training for emergency responders: Reducing risks associated with long work hours. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, <https://www.cdc.gov/niosh/emres/longhourstraining/>

NIOSH [2007]. Preventing firefighter fatalities due to heart attacks and other sudden cardiovascular events. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication Number: 2007-133, <https://www.cdc.gov/niosh/docs/2007-133/default.html>

NLEOMF [2017]. Facts & figures: causes of law enforcement deaths. Washington, DC: National Law Enforcement Officers Memorial Fund, http://www.nleomf.org/assets/pdfs/reports/fatality-reports/2017/2017-End-of-Year-Officer-Fatalities-Report_FINAL.pdf

OJP Diagnostic Center [2013]. Correctional officer wellness and safety literature review. Washington, DC: U.S. Department of Justice, Office of Justice Programs (OJP) Diagnostics Center, <https://www.ojpdagnosticcenter.org/engagements/publications/correctional-officer-wellness-and-safety-literature-review>

Oliver A, Levine R [2015]. Workplace violence: A survey of nationally registered emergency medical services professionals. *Epidemiol Res Int* 2015 (Article ID 137246): 12 pages, <http://dx.doi.org/10.1155/2015/137246>

Rutkow, L, Gable L, Links J [2011]. Protecting the Mental Health of First Responders: Legal and Ethical Considerations. *JLME Supplement*. <http://www.aslme.org/media/downloadable/files/links/1/2/12.Rutkow.pdf>

Reichard AA, Marsh SM, Tonozzi TR, Konda S, Gormley MA [2017]. Occupational injuries and exposures among emergency medical services workers. *Prehosp Emerg Care* 21(4):420-431

Taylor JA, Davis AL, Barnes B, Lacovara AV, and Patel R [2015]. Injury risks of EMS responders: evidence from the National Fire Fighter Near-Miss Reporting System. *BMJ Open* 5(6):e007562, <http://bmjopen.bmj.com/content/5/6/e007562>

Tiesman H, Gwilliam M, Konda S, Rojek J, Marsh S [2017]. Non-fatal injuries to law enforcement officers treated in U.S emergency departments: A Rise in Assaults. (Manuscript in preparation). National Institute for Occupational Safety and Health, Cincinnati, OH.

TriData Corporation [2002]. Firefighter fatality retrospective study. Prepared for Federal Emergency Management Agency, U.S. Fire Administration, National Fire Data Center, Arlington, VA, <https://www.usfa.fema.gov/downloads/pdf/publications/fa-220.pdf>

USFA (U.S. Fire Administration) [2017]. Firefighter fatality incident data- custom reports. Emmitsburg, MD: Federal Emergency Management Agency, U.S. Fire Administration, <https://apps.usfa.fema.gov/firefighter-fatalities/>

Varvarigou V, Farioli A, Korre M, Sato S, Dahabreh IJ, Kales SN [2014]. Law enforcement duties and sudden cardiac death among police officers in United States: case distribution study. *BMJ* 18(349):g6534.

Wirth M, Vena J, Smith E, Bauer S, Violanti J [2013]. The epidemiology of cancer among police officers. *Am J Ind Med* 56(4):439-453.

Zimmerman FH [2012]. Cardiovascular disease and risk factors in law enforcement personnel: a comprehensive review. *Cardiol Rev* 20(4):159-66.