HHS Public Access

Author manuscript

Am J Ind Med. Author manuscript; available in PMC 2021 August 01.

Published in final edited form as:

Am J Ind Med. 2020 August ; 63(8): 693–702. doi:10.1002/ajim.23137.

Persistent and Emerging Hazards Contributing to Work-Related Fatalities in Alaska

Devin Lucas, PhD[1], **Elizabeth Fitzgerald, MS**[1], **Samantha Case, MPH**[1], **Mary O'Connor, MS**[1], **Laura Syron, PhD**[1]

[1]National Institute for Occupational Safety and Health

Abstract

Background: Workers in Alaska have an elevated risk of dying on the job compared to workers in the rest of the United States. The purpose of this study was to measure and describe the trend in fatalities during the 15-year period 2004–2018, and to identify lingering and emerging hazards that result in fatalities.

Methods: Data on fatal work-related injuries in Alaska during 2004–2018 were obtained from the Alaska Occupational Injury Surveillance System. Descriptive statistics were calculated to identify fatality characteristics. Fatality rates were expressed as the number of deaths per 100,000 workers, and Poisson regression was used to measure the trend during the study period.

Results: During 2004–2018, there were 517 work-related fatalities in Alaska. The average annual risk of fatalities during the 15-year period was 9.6 per 100,000 workers, with no significant trend. The leading events or exposures resulting in fatal injuries to workers in Alaska during 2004–2018 were water vehicle incidents (145, 28.0%), aircraft incidents (105, 20.3%), and suicides (46, 8.9%). The number of suicides and homicides at work increased substantially during the 15-year period.

Conclusions: While deaths due to water vehicle incidents have substantially decreased, they still represent a major component of Alaska's work-related fatality profile. Aviation safety continues to be an area of concern in Alaska. Unintentional drug overdoses at work, as well as workplace violence in the form of suicides and homicides, represent emerging issues that need the attention of Alaskan occupational safety stakeholders. These findings can inform and direct fatality prevention research and practice.

Keywords

Occupational Safety; Alaska; Injury Epidemiology; Work-Related Fatalities

Devin Lucas, NIOSH Western States Division, 4230 University Drive Suite 310, Anchorage, Alaska 99508, dlucas@cdc.gov.

Authors' contributions: Devin Lucas conceptualized and designed the study, collected data, conducted data analysis, and drafted the manuscript. Elizabeth Fitzgerald collected data, conducted data analysis, and contributed to drafting the manuscript. Samantha Case contributed to the interpretation of data, drafting of the manuscript, and making critical revisions. Mary O'Connor contributed to the interpretation of data, drafting of the manuscript, and making critical revisions. Laura Syron contributed to the interpretation of data, drafting of the manuscript, and making critical revisions.

Institution at which the work was performed: National Institute for Occupational Safety and Health

Disclosure (Authors): The authors declare no conflicts of interest.

Publisher's Disclaimer: Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

1. Introduction

Work-related fatalities have been documented as a public health concern in Alaska since the 1980s, when government and academic researchers began publishing reports describing elevated risks of fatal injuries among workers in the state.[1,2,3] During the 1980s, the risk of dying on the job in Alaska was seven times higher than in the rest of the United States (US).[4] During the following two decades, 1990–2009, extensive efforts by government agencies, industry leaders, non-governmental organizations, and other stakeholders contributed to substantial reductions in the rate of work-related fatalities.[5] By 2017, the fatality rate in Alaska had declined to three times higher than the US rate, at 10.2 deaths per 100,000 workers, compared to the US rate of 3.5 deaths per 100,000 workers.[6] This decrease in the occupational fatality rate in Alaska is remarkable, yet it remains the highest in the nation. Efforts to further protect workers must continue.

Over half of work-related fatalities in Alaska during the 1990s occurred in the commercial fishing and commercial aviation industries.[4] Much of the safety research during 1990–2009 was focused on preventing deaths in these two industries.[5] Reductions in Alaskan commercial fishing fatalities have been observed since 1990, both overall[4] and in specific fisheries.[5,7] The implementation of federal regulations, fishery management policy changes, marine safety training, and fleet-specific safety programs have likely contributed to this decline.[4,5,7,8,9] However, persistent and emerging challenges have resulted in the continued incidence of fishing fatalities in Alaska. Drowning remains the leading cause of death in this workforce, most often the result of vessel disasters and falls overboard.[7,10] Recent surveillance findings show an increase in suicides and unintentional drug overdoses among commercial fishermen,[7,10] mirroring statewide patterns in the general population.[43,44]

During the 1990s, aircraft crashes were the second leading incident type resulting in work-related death in Alaska, and commercial pilots in Alaska experienced an occupational fatality rate nearly 100 times greater than the rate for all US workers, and five times greater than the rate for all US pilots.[4] In 2000, the US Congress funded the Alaska Interagency Aviation Safety Initiative with the goal of decreasing occupational aircraft crash fatalities in half by 2010.[11] This multifaceted public health approach sought to improve the industry's safety culture and provide tools for pilots to avoid flight into poor weather conditions.[12] These efforts resulted in a 50% decrease in commercial pilot fatalities from 1990–1999 to 2000–2009.[13] In spite of this initiative, the occupational fatality rate for pilots in Alaska during 2000–2009 was still 50 times greater than the rate for all US workers,[13] and greater than three times the rate for all US pilots.[6] Research is needed to evaluate the longer-term effectiveness of the initiative, characterize more recent crashes and fatalities, and provide recommendations for future efforts.

An epidemiologic profile of all work-related fatalities in Alaska found a substantial decrease in the number of fatalities over the 20-year period 1990–2009.[5] The study attributed the decline primarily to safety improvements in the commercial aviation and commercial fishing industries. No research has been published describing overall trends in the total burden of work-related fatalities in Alaska since 2009. Changes in the patterns of fatalities, including

changes in predominant demographic characteristics, industries and occupations, and causes of fatalities, have not been documented since that time either. The purpose of this study was to measure and describe the trend in fatalities during the 15-year period 2004–2018, and to identify lingering and emerging hazards that result in fatalities. The findings can be utilized to inform and direct future fatality prevention research and practice.

2. Methods

Data on fatal work-related injuries in Alaska during 2004–2018 were obtained from the Alaska Occupational Injury Surveillance System (AOISS). AOISS is an actively populated database maintained by the National Institute for Occupational Safety and Health, containing descriptive information on all fatal work-related injuries in Alaska beginning in 1990. Cases are identified through surveillance of death certificates, media outlets, law enforcement notifications, and notifications from other agencies such as the Coast Guard and National Transportation Safety Board. Data housed in AOISS are abstracted from documents such as death certificates, medical examiner reports, and law enforcement investigations produced by multiple local, state, and federal agencies.

The AOISS database applies the following definition for an acute traumatic injury: “any wound or damage to the body resulting from acute exposure to energy… caused by a specific event or incident within a single workday or shift.”[14] The criteria for defining work-relatedness in AOISS follows those established by the Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI).[14] Fatal injuries caused by suicide, homicide, and drug overdoses are included. Deaths due to illness, such as coronary artery disease, that occurred during work hours are not included.

Coding and data entry for AOISS are performed by trained NIOSH research staff and verified using an independent review protocol to ensure quality control. The database includes key data elements coded with standardized classification systems commonly used in occupational injury research, such as the Occupational Injury and Illness Classification System (OIICS)[15] and Standard Occupational Classification (SOC).[16] OIICS includes four data elements describing characteristics of injuries: nature of injury (i.e., the physical characteristics of the injury, such as a laceration), body part affected, source of injury (i.e., objects, substances, equipment, and other responsible factors), and the event or exposure resulting in injury (i.e., manner in which the injury was produced or inflicted by the source).

Additional data in AOISS include demographic characteristics of each victim, the location of the fatal incident, and weather conditions at the time. Other unique industry-specific data fields for commercial fishing and aviation incidents are also included, such as the type of fishing vessel or the occurrence of controlled flight into terrain. Controlled flight into terrain occurs when an airworthy aircraft is flown, under the control of a qualified pilot, into terrain, water or obstacles, with inadequate awareness of the impending collision on the part of the pilot.[17]

Data for this study were exported from AOISS and loaded into Stata version 14.2 for analysis. The 15-year period was divided into three 5-year periods (2004–2008, 2009–2013,

and 2014–2018) to smooth year-to-year volatility in fatality characteristics and combine incidents with small yearly counts into larger groups for analysis. Descriptive statistics such as frequency and percent distributions, cross-tabulations, and measures of central tendency and dispersion were calculated to identify fatality patterns across the three 5-year time periods and describe injury characteristics. To calculate annual fatality rates, worker count data were obtained from the Bureau of Labor Statistics Current Employment Statistics.[18] Fatality rates were expressed as the number of deaths per 100,000 workers per year. Trends were analyzed using two techniques. First, Poisson regression was used to calculate the incidence rate ratio (IRR) for the 15-year time period using the annual count of fatalities and the annual workforce estimates as the exposure. Second, to validate the results of the Poisson regression, the Extended Mantel-Haenszel Chi Square test was used to measure the trend in the three 5-year period rates. This study was reviewed by the Institutional Review Board and determined to be “non-human subjects research” because all subjects were deceased.

3. Results

During 2004–2018, there were 517 work-related fatalities in Alaska, a mean of 34.5 deaths per year. The average annual risk of fatalities during the 15-year period was 9.6 deaths per 100,000 workers, with a high of 13.4 in 2006 and a low of 5.8 in 2009 (Table 1). Poisson regression of the annual rate found no statistically significant trend (IRR=0.9941; p=0.566). Collapsing the fatality data into three 5-year periods revealed an apparent slight decline in the risk of fatalities, from 10.3 deaths per 100,000 workers during 2004–2008 to 9.2 during 2014–2018 (Table 1), but the decline was not statistically significant (χ^2=1.037; p=0.309).

Decedents were predominantly white (334, 71.8%), male (487, 94.2%), and Alaskan residents (362, 70.0%) (Table 2). The average age of decedents was 41.7 years old, ranging from 16 to 86 years old. Fatalities among Black/African American workers increased steadily from one fatality during 2004–2008 to six during 2014–2018, resulting in a total of ten fatalities (2.1%) over the course of the 15-year study period. Fatalities among American Indian and Alaska Native workers also increased. Most other known demographics remained relatively consistent throughout the three 5-year periods (Table 2).

Among the six major geographic regions of Alaska, the majority of work-related fatalities occurred in the Southwest Region of Alaska (164, 31.7%), followed by the Anchorage/ Matanuska-Susitna Region (102, 19.7%), and the Southeast Region (94, 18.1%) (Figure).

Throughout the entire 15-year period, most work-related fatalities occurred during July (77, 14.9%), August (68, 13.2%), June (62, 12.0%), and October (49, 9.5%). July was the deadliest month for both pilots (15 fatalities) and commercial fishing workers (27 fatalities). Commercial fishing workers also accounted for 20 of the fatalities in the month of October (40.8%).

As classified by OIICS Nature of Injury codes, the most common nature of injury among workers was drowning (167, 32.3%), followed by multiple blunt force injuries to the brain and other internal organs (115, 22.2%), and gunshot wounds (50, 9.7%). Body systems (e.g.,

respiratory system, circulatory system) were the most frequently affected part of the body (233, 45.1%). The combined area of the head, neck, and trunk was the second most affected (115, 22.2%), followed by isolated injuries to brain (39, 7.5%).

Eighteen occupational groups experienced more than five fatalities during the 15-year study period, representing 91.8% of all fatalities (Table 3). Commercial fishing workers had the highest number of fatalities over the entire period (142 deaths), and in each of the three 5-year periods.

The leading events or exposures resulting in fatal injuries to workers in Alaska during 2004–2018 were water vehicle incidents (145, 28.0%), aircraft incidents (105, 20.3%), and suicides (46, 8.9%) (Table 4). The 145 deaths from water vehicle incidents occurred during 109 individual events, of which 24 (22.0%) were related to inclement weather. Fatalities from water vehicle incidents appeared to decrease dramatically over the three 5-year periods (Table 4). The most common type of water vehicle incident was “capsizing or sinking water vehicles,” with resulting fatalities that decreased from 35 during 2004–2008 to 16 during 2014–2018. The second leading type of water vehicle incident was falling overboard, which accounted for 21 deaths during 2004–2008, 23 deaths during 2009–2013, and 13 deaths during 2014–2018. Drowning was the most frequent cause of death in water vehicle incidents (117, 80.7%). The most common occupations of workers who died in water vehicle incidents were commercial fishing workers (107, 73.8%), water transportation workers (e.g., captains and crewmembers of cargo or passenger vessels) (21, 14.5%), and seafood processors (5, 3.4%).

Similar to water vehicle incidents, aircraft incidents often resulted in multiple fatalities. The 105 work-related fatalities due to aircraft incidents were a result of 69 unique events. Of these events, 26 (37.7%) were weather-related crashes resulting in 39 work-related deaths. Seventeen crashes (24.6%) were determined to be controlled flight into terrain. Pilot fatalities due to in-flight crashes increased from the first 5-year period to the second, and then remained relatively constant (Table 5); however, the number of controlled flight into terrain crashes varied from three during 2004–2008, to nine during 2009–2013, to five during 2014–2018, resulting in 23 occupational fatalities. Multiple blunt force injuries to the brain and other internal organs was the most common cause of death in aircraft incidents (89, 84.7%). There was no trend in the total number of fatalities attributed to aircraft incidents during 2004–2018 (Table 4), and the number of separate incidents remained relatively consistent with 22 incidents during 2004–2008, 24 during 2009–2013, and 23 during 2014–2018. The most frequent occupations of workers who died in aircraft incidents were pilots (70, 66.7%), water transportation workers (6, 5.7%), and tour and travel guides (4, 3.8%).

The number of suicides which occurred at work increased substantially during the 15-year period, from four during 2004–2008, to 20 during 2009–2013, to 22 during 2014–2018 (Table 4). Gunshot wounds were the most frequent cause of death by suicide (24, 52.2%) followed by hangings (10, 21.7%). The most prevalent occupations of workers who died by suicide were military personnel (13, 28.2%), commercial fishing workers (7, 15.2%), and installation, maintenance, and repair workers (5, 10.9%). Suicides among workers in the

installation, maintenance, and repair occupations changed from zero during 2004–2008, to three during 2009–2013, to two during 2014–2018 (Table 5). The number of suicides among commercial fishing workers appeared to increase over the study period. Military personnel suicides increased from zero during 2004–2008 to nine during 2009–2013, and decreased to four during 2014–2018, but continued to be the most common incident type among these workers (Table 5).

Additionally, the number of homicides increased, from seven during 2004–2008, to 13 during 2009–2013, and remained at 13 during 2014–2018 (Table 4). Of the 33 total homicides, the cause of death was predominantly gunshot wounds (23, 69.7%). The occupations of workers who died due to homicide were most frequently law enforcement officers (6, 18.2%), other managers (4, 12.1%), and motor vehicle operators (3, 9.1%). Homicide was the leading incident type resulting in death among the 30 women who died in the workplace during the 15-year study period (7, 23.3%). Of these seven victims, two were killed by patients, two by former co-workers, and three by other perpetrators.

Worker fatalities resulting from falls to a lower level remained fairly constant throughout the study period. The causes of death for these incidents were primarily drowning (15, 38.5%) and intracranial injuries (13, 33.3%). All 15 drowning victims fell from docks into water. Workers who died from falls to a lower level were most often commercial fishing workers (11, 28.2%), construction workers (6, 15.4%), and water transportation workers (4, 10.3%).

Fatalities resulting from being struck by objects or equipment appeared to decrease over the 15-year study period, from 11 during 2004–2008, to 10 during 2009–2013, to five during 2014–2018. The causes of death from these events were predominantly multiple traumatic injuries (9, 34.6%), multiple intracranial injuries (5, 19.2%), and intracranial injuries with injuries to internal organs (5, 19.2%). Forest, conservation, and logging workers (5, 19.2%), construction workers (5, 19.2%), and extraction workers (4, 15.4%) experienced the highest number of fatalities due to being struck by objects or equipment.

Roadway incidents involving motorized vehicles resulted in 25 fatalities across the 15-year study period. Most fatalities were the result of non-collision events (21 deaths, 84.0%), rather than collisions between two vehicles (4 deaths, 16.0%). Roadway incidents involving semi-trucks resulted in seven work-related fatalities (28.0%), followed by passenger vans (5, 25.0%). The use of drugs or alcohol by the deceased worker was confirmed in two cases. The causes of death from roadway incidents were primarily intracranial injuries and injuries to internal organs (11, 44.0%) and multiple traumatic injuries (6, 24.0%). Roadway incidents most commonly killed motor vehicle operators (14, 56.0%) and seafood processors (3, 12.0%).

Twenty-three fatalities resulted from drug or alcohol overdoses during the study period. There was no apparent trend in the number of deaths, which fluctuated between the three 5-year periods. Commercial fishing workers were the most commonly affected group (8, 34.8%), with the remainder of fatalities spanning 12 occupational groups.

4. Discussion

This study found the risk of dying on the job in Alaska did not decrease significantly during the 15-year period 2004–2018. Workplace fatalities continue to occur in Alaska at a rate three times higher than the rest of the US workforce (10.2 compared to 3.5 in 2017).[6] The findings of this study should be a call to action for industry safety professionals, labor groups, regulators, and other stakeholders to work together with renewed effort to prevent work-related fatalities.

Commercial fishing workers and pilots continue to have high numbers of fatalities in Alaska, most often during summer months when these workers are most active. While there was a decrease in the number of commercial fishing fatalities between the first and second 5-year periods, it then increased in the last 5-year period. The number of pilot deaths remained fairly consistent throughout the study period. Out of all occupations in Alaska, commercial fishing workers and pilots consistently had the highest numbers of work-related fatalities, and together these two occupations accounted for 41% of all fatalities during 2004–2018. Previous studies going back to the 1980s and 1990s reached similar conclusions,[1,2] and substantial efforts have been made to reduce hazards in the fishing and aviation industries.[4,5] The findings of this study indicate that additional prevention-oriented research and targeted interventions are still needed to protect pilots and fishermen from deadly hazards.

Although water vehicle incidents resulted in the highest number of fatalities during 2004–2018, they appeared to decrease dramatically over the 15-year period. Water vehicle incidents primarily involved commercial fishing workers and were mainly the result of vessel sinkings and falls overboard. Commercial fishing fatalities due to vessel capsizings and sinkings were reduced by almost half after 2004–2008. Preventing loss of life in this maritime workforce has been a priority for industry stakeholders for decades, making the measurable reduction in vessel sinking deaths a promising finding. Drowning deaths from falls overboard, however, remained a significant problem throughout the study period. Further efforts to promote personal flotation device use and other prevention strategies, such as eliminating fall hazards and participating in response and recovery training, are needed as highlighted in previous studies.[7,10,19]

As an emerging non-maritime issue, drug overdose deaths at work have increased, disproportionally affecting commercial fishing workers compared with other Alaskan workers. This finding is consistent with other studies that show elevated rates of overdose deaths among agriculture, forestry, and fishing workers, both generally[20] and at work.[21] Evidence suggests that prescription drug use may be both a risk factor for and consequence of work-related injuries.[22] Researchers should continue to explore how work impacts drug use and overdoses.

Work-related fatalities caused by aircraft incidents did not decrease substantially during the study period. Efforts to improve aviation safety in the late 1990s and early 2000s focused on communicating weather information, such as through weather cameras and the mike-in-hand program, and the Medallion Foundation, a non-profit aviation safety organization created to raise safety standards and enhance safety culture.[13] Previous research by NIOSH indicated a

50% decrease in number of fatal work-related aircraft crashes and number of work-related fatalities between 2000–2004 and 2005–2009; however, both 2000 and 2001 saw a high number of work-related fatalities in aviation incidents.[12] This downward trend did not continue into the time period starting in 2004.

Previous research also found weather was a leading cause of work-related aircraft crashes and fatalities.[12] In addition to the direct influence of weather conditions on aircraft crashes, a strong association was found to exist between flights originating in good weather with continuation into poor weather conditions and controlled flight into terrain crashes.[23] Weather-related crashes traditionally have a lethality range of 70 to 90%,[24] and controlled flight into terrain crashes among commercial operators in Alaska were 10 times more likely to be fatal than non-controlled flight into terrain crashes.[23]

Both the Federal Aviation Administration (FAA) and the National Transportation Safety Board (NTSB) have made efforts to address the increase in controlled flight into terrain incidents. The FAA recommended commercial operators fly using aircraft instruments for navigation and approach to landing when possible; incorporate methods to detect and escape poor weather conditions in pilot training; complete flight risk assessments prior to all flights; and promote a positive safety culture within aviation companies.[25]

Recommendations from the NTSB include improvement of voluntary controlled flight into terrain-prevention training programs with special attention paid to the challenges of flying in mountainous terrain, at low altitudes, and limitations of the Alaska flight infrastructure, particularly weather observations, communications, and navigation aids.[26] While enroute weather communications capacities have improved, providing communications equipment throughout Alaska to allow use of aircraft instruments for navigation and approach to landing[27] may allow flight at safer altitudes and prevent inadvertent entry into areas of poor weather. Enhancement of weather reporting capabilities is needed to allow aircraft to safely approach, depart, and land at airports.[28] Research to support controlled flight into terrain prevention and surveillance of crashes should continue in an effort to determine potential risk factors among operators and pilots for weather-related crashes.

Workplace suicide was the third leading cause of fatal work-related injury for the 15-year period. The proportion of workplace fatalities caused by suicide in Alaska is more than twice that observed nationally (13.2% in Alaska during 2014–2018 compared to 5.3% in the US in 2017).[6] This critical public health issue is also reflected in the state's general population. In 2017, Alaska had the second highest suicide mortality rate in the nation.[30] While the influence of workplace factors on mental health and suicide was not measured in this study, the dramatic rise and sustained number of suicides at work is a major cause for concern and requires immediate attention from employers and public health professionals. Workplace suicides accounted for over half of fatalities among military personnel and nearly one-fifth of fatalities among installation, maintenance, and repair workers.

The high incidence of deaths by suicide among members of the armed forces has been well-documented, with suicide risk factors including intimate partner relationship issues, legal and administrative challenges (e.g., reduction in rank), previous deployments, mental health

disorder diagnoses, and alcohol-related disorders.[31,32,33] Because suicide is a major contributor to mortality in this workforce, a multifaceted approach to prevention is needed in order to identify at-risk individuals and create protective environments to promote help-seeking.[34]

Previous studies have found that workers in installation, maintenance, and repair have suicide rates over twice the US rate, for all suicides,[35] and for workplace suicides.[36] Specific risk factors for suicide among these workers are unclear; however, previous literature suggests exposure to vapors and solvents among automobile mechanics could be associated with depressive disorders.[37] Additional research is warranted to identify workplace exposures or economic stressors that could be suicidal risk factors for this occupation.

Similar to the rise in workplace suicides, work-related homicides in Alaska have increased over time. During 2014–2018, homicides caused nearly 8% of work-related fatalities, a level identical to national statistics in 2017.[29] Women were over-represented, making up 21.2% of homicide victims despite accounting for only 5.8% of all worker fatalities. Homicide was the leading cause of workplace fatalities among women, at 23.3%, which also mirrors national statistics.[29] The American Society of Safety Professionals' (ASSP) recent report on women and safety in the modern workplace highlighted workplace violence as a key issue. The report's recommendations for minimizing violence included the following: educating and training employees on this issue; evaluating building security policies and procedures; offering employee assistance programs; and providing a hotline so employees can report any potential issues happening at work.[38] Healthcare workers are also at risk for violence on the job. NIOSH has developed a workplace violence prevention course for nurses.[39]

5. Conclusion

This study described several persistent and emerging problems that should be prioritized to improve occupational safety in Alaska. While deaths due to water vehicle incidents have substantially decreased, they still represent a major component of Alaska's work-related fatality profile. Aviation safety also continues to be an area of concern in Alaska and an issue that needs more attention from all stakeholders. Unintentional drug overdoses at work, as well as workplace violence in the form of suicides and homicides, represent emerging issues that need the attention of Alaskan occupational safety stakeholders. These types of fatalities are the result of hazards that are not always recognized by traditional occupational safety and health education and practice. Safety professionals and regulators may need assistance from other fields and specialties to successfully identify these issues and develop appropriate interventions.

New approaches are clearly needed to address worker fatalities. Occupational fatalities are largely preventable with effective safety management systems and a commitment to identifying and controlling hazards at all levels of an organization.[40] Adoption of key components, including safety policy, safety risk management, safety assurance, and safety promotion, provides for a systematic approach to managing reasonable levels of safety risk.[41] Principles of risk assessment and risk management can be practiced by organizations of all sizes and types,[42] from a self-employed construction contractor or fishing vessel owner to

a hospital or seafood processing company with thousands of employees. Implementation of safety management systems may be the comprehensive approach needed to reduce worker fatalities in Alaska's dynamic and complex work environment.

Acknowledgements:

The authors thank the State of Alaska, Division of Public Health for assistance identifying cases and documents from which to collect data.

Funding:

The authors report that there was no funding source for the work that resulted in the article or the preparation of the article.

References

1. Centers for Disease Control and Prevention, 1987. Traumatic occupational fatalities--United States, 1980–1984. Morb Mortal Wkly Rep, 36(28), 461–464, 469–470.
2. Schnitzer P, 1987. The epidemiology of work-related injury fatalities in Alaska, 1980–1985. (MS), University of Alaska Anchorage, Anchorage, Alaska.
3. Weiss L, Booker J, Wigglesworth D, 1989. Emerging public health issues in Alaska: occupational and environmental health. Alaska Med, 31(3), 97–102. [PubMed: 2669551]
4. National Institute for Occupational Safety and Health, 2002. Surveillance and prevention of occupational injuries in Alaska: a decade of progress, 1990–1999. NIOSH Publication No. 2002–15. Cincinnati, OH: National Institute for Occupational Safety and Health.
5. Lincoln J, O'Connor M, Retzer K, Hill R, Teske T, Woodward C, … Conway G, 2013. Occupational fatalities in Alaska: two decades of progress, 1990–1999 and 2000–2009. J Safety Res, 44, 105–110. [PubMed: 23398711]
6. Bureau of Labor Statistics, 2018a. Census of Fatal Occupational Injuries, 2017. Washington, DC: Bureau of Labor Statistics.
7. Lucas D, Case S, 2018. Work-related mortality in the US fishing industry during 2000–2014: New findings based on improved workforce exposure estimates. Am J Ind Med; 61(1): 21–31. [PubMed: 28833290]
8. Lincoln J, Husberg B, Conway G, 2001. Improving safety in the Alaskan commercial fishing industry. Int J Circumpolar Health; 60(4): 705–713. [PubMed: 11768452]
9. Lincoln J, Mode N, Woodley C, 2007. An Evaluation of Quota-Based Management Systems in Alaska. North Pacific Research Board Project Final Report.
10. Case S, Kloczko D, Lucas D, Mason K, Syron L, Teske T, 2017. Commercial fishing fatality summary: Alaska region. NIOSH Publication No. 2017–171. Anchorage, AK: National Institute for Occupational Safety and Health.
11. National Institute for Occupational Safety and Health, 2013. NIOSH partners with organizations and industry to reduce aviation fatalities in Alaska. NIOSH Publication Number 2013–137. Anchorage, AK: National Institute for Occupational Safety and Health.
12. Centers for Disease Control and Prevention, 2011. Occupational aviation fatalities—Alaska, 2000–2010. Morb Mortal Wkly Rep, 60(25), 837–840.
13. Mode N, O'Connor M, Conway G, Hill R, 2012. A multifaceted public health approach to statewide aviation safety. American Journal of Industrial Medicine, 55, 176–186. [PubMed: 22170605]
14. Bureau of Labor Statistics, 2013. Census of Fatal Occupation Injuries (CFOI): Definitions. Retrieved from http://www.bls.gov/iif/oshcfdef.htm.
15. Bureau of Labor Statistics, 2012. Occupational Injury and Illness Classification System. Retrieved from https://www.bls.gov/iif/oshoiics.htm.
16. Office of Management and Budget, 2010. Standard Occupational Classification Manual. National Technical Information Service. Washington: DC, p. 377.

17. Federal Aviation Administration, 2003. General aviation controlled flight into terrain awareness. Advisory Circular 61–134. Retrieved from https://www.faasafety.gov/gslac/alc/libview_normal.aspx?id=6583.
18. Bureau of Labor Statistics, 2019. Current Employment Statistics, 2004–2018. Retrieved from https://www.bls.gov/ces/.
19. Case S, Lincoln J, Lucas D, 2018. Fatal Falls Overboard in Commercial Fishing—United States, 2000–2016. Morb Mortal Wkly Rep; 67(16): 465–469.
20. Massachusetts Department of Public Health, 2018. Opioid-related Overdose Deaths in Massachusetts by Industry and Occupation, 2011–2015. Massachusetts Department of Public Health, Occupational Health Surveillance Program, Boston MA. Retrieved from https://www.mass.gov/files/documents/2018/08/15/opioid-industry-occupation.pdf.
21. Tiesman H, Konda S, Cimineri L, Castillo D, 2019. Drug overdose deaths at work, 2011–2016. Inj Prev; Epub ahead of print. doi: 10.1136/injuryprev-2018-043104.
22. Kowalski-McGraw M, Green-McKenzie J, Pandalai S, Schulte P, 2017. Characterizing the Interrelationshipsof Prescription Opioid and Benzodiazepine Drugs With Worker Health and Workplace Hazards. J Occup Environ Med; 59(11): 1114–1126. [PubMed: 28930799]
23. Thomas T, Benzyl D, Manwaring J, Conway G, 2000. Controlled flight into terrain accidents among commuter and air taxi operators in Alaska. Av Space Env Med 71(11), 1098–1103.
24. Aircraft Owners and Pilot Association, 2017. 26th Joseph T. Nall report: General aviation accidents in 2014. Retrieved from http://download.aopa.org/advocacy/0822_Nall_Report.pdf.
25. Federal Aviation Administration, 2016. Correspondence to owner/operator. Flight Standards Division, Alaska Region.
26. National Transportation Safety Board, 2018a. Safety recommendation A-18-013. Retrieved from https://www.ntsb.gov/investigations/_layouts/ntsb.recsearch/Recommendation.aspx?Rec=A-18-013.
27. National Transportation Safety Board, 2018b. Safety recommendation A-18-0186. Retrieved from https://www.ntsb.gov/investigations/_layouts/ntsb.recsearch/Recommendation.aspx?Rec=A-18-016.
28. National Transportation Safety Board, 2018c. Safety recommendation A-18-017. Retrieved from https://www.ntsb.gov/investigations/_layouts/ntsb.recsearch/Recommendation.aspx?Rec=A-18-017.
29. Bureau of Labor Statistics, 2018b. There were 500 workplace homicides in the United States in 2016. Retrieved from https://www.bls.gov/opub/ted/2018/there-were-500-workplace-homicides-in-the-united-states-in-2016.htm.
30. Centers for Disease Control and Prevention, 2018. Stats of the State Alaska. National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/pressroom/states/alaska/alaska.htm.
31. Hyman J, Ireland R, Frost L, Cottrell L, 2012. Suicide Incidence and Risk Factors in an Active Duty US Military Population. American Journal of Public Health; 102(S1): S138–S146. [PubMed: 22390588]
32. LeardMann C, Powell T, Smith T, 2013. Risk Factors Associated with Suicide in Current and Former US Military Personnel. JAMA; 310(5): 496–506. [PubMed: 23925620]
33. Pruitt L, Smolenski D, Bush N, Tucker J, Issa F, Hoyt T, Reger M, 2019. Suicide in the military: understanding rates and risk factors across the United States' armed forces. Military Medicine; 184(1): 432–437. [PubMed: 30423136]
34. Stone D, Holland K, Bartholow B, Crosby A, Davis S, Wilkins N, 2017. Preventing suicide: a technical package of policies, programs, and practices. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.
35. Peterson C, Stone D, Marsh S, Schumacher P, Tiesman H, McIntosh W, Lokey C, Trudeau A, Bartholow B, Luo F, 2018. Suicide rates by major occupational group – 17 States, 2012 and 2015. Morb Mortal Wkly Rep; 67(45): 1253–1260.
36. Tiesman H, Konda S, Hartley D, Menendez C, Ridenour M, Hendricks S, 2015. Suicide in U.S. workplaces, 2003–2010: a comparison with non-workplace suicides. Am J Prev Med; 48(6): 674–682. [PubMed: 25794471]

37. Schwartz E, 1987. Proportionate mortality ratio analysis of automobile mechanics and gasoline service station workers in New Hampshire. Am J Ind Med; 12(1): 91–99. [PubMed: 3618603]

38. American Society of Safety Professionals, 2019. Women and safety in the modern workplace: Creating a diverse and inclusive workplace can boost safety, productivity profitability. Retrieved from https://www.assp.org/docs/default-source/default-document-library/assp_women_and_safety_report_0419.pdf?sfvrsn=28.

39. Hartley D, Webb S, 2017. Workplace Violence Prevention Course for Nurses. NIOSH Publication No. 2017–114. Morgantown, WV: National Institute for Occupational Safety and Health.

40. American National Standards Institute, 2017. Occupational health and safety management systems. ANSI/ASSP Z10–2012 (R2017). Park Ridge, IL: American Society of Safety Professionals.

41. Federal Aviation Administration, 2017. Safety Management System Components. Retrieved from https://www.faa.gov/about/initiatives/sms/explained/components/

42. American National Standards Institute, 2011. Risk assessment techniques. ANSI/ASSP Z690.3–2011. Des Plaines, IL: American Society of Safety Professionals.

43. State of Alaska, 2019. AKVDRS Suicide Death Update – Alaska, 2012–2017. Retrieved from http://epibulletins.dhss.alaska.gov/Document/Display?DocumentId=2000

44. State of Alaska, 2017. Update on Drug Overdose Deaths – Alaska, 2016. Retrieved from http://epibulletins.dhss.alaska.gov/Document/Display?DocumentId=1937

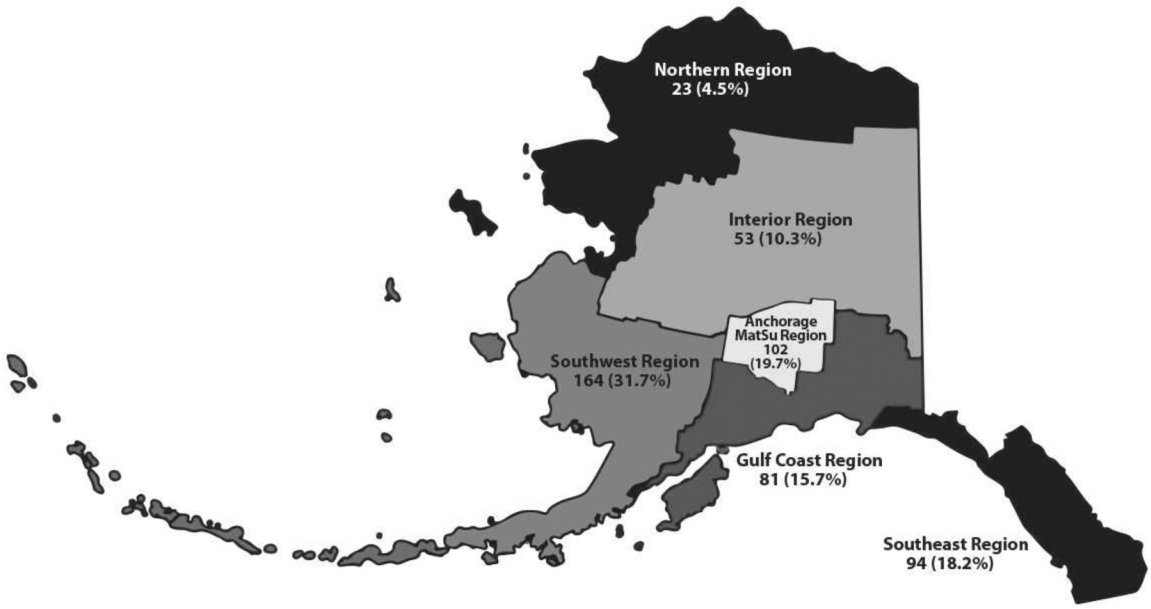

FIGURE.
Location of work-related fatalities in Alaska, 2004–2018 (n=517)

TABLE 1

Annual counts and rates of work-related fatalities in Alaska, 2004–2018 (n=517)

Year	Deaths	Workers	Rate[a]	95% CI[d]
Annual Fatality Data[b]				
2004	38	336,732	11.3	8.1, 15.3
2005	22	344,549	6.4	4.0, 9.7
2006	47	349,668	13.4	9.9, 17.9
2007	39	350,832	11.1	7.9, 15.2
2008	33	356,107	9.3	6.4, 13.0
2009	21	359,640	5.8	3.6, 8.9
2010	38	361,909	10.5	7.4, 14.4
2011	44	365,833	12.0	8.7, 16.2
2012	34	365,544	9.3	6.4, 13.0
2013	34	365,342	9.3	6.4, 13.0
2014	31	365,412	8.5	5.8, 12.0
2015	26	363,377	7.2	4.7, 10.5
2016	43	362,233	11.9	8.6, 16.0
2017	33	360,768	9.1	6.3, 12.9
2018	34	356,910	9.5	6.6, 13.3
5-Year Period Fatality Data[c]				
2004–2008	179	1,737,888	10.3	8.8, 11.9
2009–2013	171	1,818,268	9.4	8.1, 10.9
2014–2018	167	1,808,699	9.2	7.9, 10.7

[a] Deaths per 100,000 workers

[b] IRR = 0.9941; p=0.566

[c] Chi^2=1.037; p=0.309

[d] Poisson Distribution

TABLE 2

Demographic characteristics of work-related fatality victims in Alaska during 2004–2018 (n=517)

	2004–2008 (n=179)	2009–2013 (n=171)	2014–2018 (n=167)	Total (n=517)
Sex				
Male	170 (95.0%)	163 (95.3%)	154 (92.2%)	487 (94.2%)
Female	9 (5.0%)	8 (4.7%)	13 (7.8%)	30 (5.8%)
Age				
<18	0 (0.0%)	1 (0.6%)	1 (0.6%)	2 (0.4%)
18–24	21 (11.7%)	28 (16.4%)	19 (11.4%)	68 (13.2%)
25–44	89 (49.7%)	65 (38.0%)	68 (40.7%)	222 (42.9%)
45–64	64 (35.8%)	61 (35.7%)	70 (41.9%)	195 (37.7%)
>= 65	5 (2.8%)	16 (9.3%)	9 (5.4%)	30 (5.8%)
Race/Ethnicity				
White (non-Hispanic)	113 (74.3%)	109 (72.7%)	112 (68.7%)	334 (71.8%)
Am Indian/AK Native	16 (10.6%)	18 (12.0%)	24 (14.7%)	58 (12.5%)
Hispanic	11 (7.2%)	11 (7.3%)	12 (7.4%)	34 (7.3%)
Asian	4 (2.6%)	7 (4.7%)	6 (3.7%)	17 (3.7%)
Black/African American	1 (0.7%)	3 (2.0%)	6 (3.7%)	10 (2.1%)
Other	7 (4.6%)	2 (1.3%)	3 (1.8%)	12 (2.6%)
Unknown	27	21	4	52
Residency				
Alaska	125 (69.8%)	117 (68.4%)	120 (71.9%)	362 (70.0%)
US (not Alaska)	44 (24.6%)	46 (26.9%)	41 (24.5%)	131 (25.4%)
Outside of US	10 (5.6%)	8 (4.7%)	6 (3.6%)	24 (4.6%)

TABLE 3

Occupations in Alaska with >5 fatalities during 2004–2018

	2004–2008 (n= 168)	2009–2013 (n= 160)	2014–2018 (n= 149)	Total (n= 475)
Commercial Fishing Workers	55	39	48	142
Pilots	18	29	23	70
Construction Workers	13	11	11	35
Water Transportation Workers	18	9	7	34
Installation/Maint./Repair Workers	10	9	7	26
Military Personnel	3	14	7	24
Motor Vehicle Operators	11	6	5	22
Seafood Processors	6	7	9	22
Extraction Workers	5	7	4	16
Material Moving Workers	3	7	3	13
Law Enforcement Officers	1	6	4	11
Tour/Travel Guides	4	5	1	10
Life/Physical/Social Scientists	7	1	2	10
Forest/Conserv./Logging Workers	1	4	5	10
Other Managers	2	4	4	8
Assembly/Production Workers	5	1	2	8
Healthcare Workers	5	0	3	8
Building and Grounds Maintenance	1	1	4	6

TABLE 4

Event or exposure resulting in fatal injuries in Alaskan workers, 2004–2018 *

	2004–2008 (n=179)	2009–2013 (n=171)	2014–2018 (n=167)	Total (n=517)
Water vehicle incidents	67	43	35	145
Aircraft incidents	35	37	33	105
Suicide	4	20	22	46
Falls to lower level	15	10	14	39
Homicide	7	13	13	33
Struck by object/equipment	11	10	5	26
Roadway incidents involving motor vehicle	9	3	13	25
Drug or alcohol overdoses	8	4	11	23
Non-roadway incidents involving motor vehicle	8	7	2	17
Caught or compressed by equipment/objects	4	6	3	13
Struck by collapsing structure/equipment/material	2	5	4	11
Diving incidents	2	4	4	10
Exposure to electricity	1	3	1	5
Pedestrian vehicular incidents	1	2	1	4
Injury by person—unintentional	0	1	3	4
Animal and insect related incidents	0	1	2	3
Fires	2	1	0	3
Explosions	2	1	0	3
Falls on same level	1	0	1	2

* The numbers in this table are counts of fatalities, not incidents. Some incidents result in multiple fatalities.

TABLE 5

Most frequent causes of work-related fatalities in Alaska among occupations with ≥ 20 deaths during 2004–2018

	2004–2008	2009–2013	2014–2018	Total
Commercial Fishing Workers				
Capsized or sinking water vehicle	29	13	14	57
Fall or jump from water vehicle	13	14	11	37
Falls from dock	5	0	6	11
Unintentional drug overdose	0	3	5	8
Suicide	0	2	5	7
Other	8	7	7	22
Total	55	39	48	142
Pilots				
In-flight crashes	12	20	19	51
Crashes during take-off or landing	6	8	2	16
Other	0	1	2	3
Total	18	29	23	70
Construction Workers				
Struck by or other contact with objects	4	4	5	13
Heavy equipment related incidents	4	4	2	10
Falls to lower level	3	1	2	6
Other	2	2	2	6
Total	13	11	11	35
Water Transportation Workers				
Fall or jump from water vehicle	5	7	1	13
Aircraft crashes	6	0	0	6
Capsized or sinking water vehicle	4	0	0	4
Other	3	2	6	11
Total	18	9	7	34
Installation/Maint./Repair Workers				
Aircraft crashes	4	3	0	7
Suicide	0	3	2	5
Other	6	3	5	14
Total	10	9	7	26
Military Personnel				
Suicide	0	9	4	13
Transportation incidents	3	2	1	6
Other	0	3	2	5
Total	3	14	7	24
Motor Vehicle Operators				
Motor vehicle incident on roadway	7	2	5	14
Struck by or other contact with objects	2	2	0	4

	2004–2008	2009–2013	2014–2018	Total
Homicide	2	1	0	3
Other	0	1	0	1
Total	11	6	5	22
Seafood Processors				
Water vehicle incidents	2	3	0	5
Struck by or other contact with objects	3	1	1	5
Other	1	3	8	12
Total	6	7	9	22