



**NATIONAL OCCUPATIONAL RESEARCH AGENDA (NORA)**

**NATIONAL OCCUPATIONAL RESEARCH AGENDA FOR AGRICULTURE,  
FORESTRY, AND FISHING**

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## **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 are expected to reduce the occurrence of injuries and illnesses at work. Unveiled in 1996, NORA has become a research framework for the Nation and 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 Agriculture, Forestry, and Fishing (AgFF) Sector encompasses the NAICS code groupings 111 through 115. Activities of this sector include growing crops, raising animals, harvesting timber, and harvesting fish and other animals from farms, ranches, or natural habitats (Executive Office of the President OMB, 2007). The NORA AgFF Sector Council made the decision to also include seafood processing (NAICS code 311710), which generally occurs on board commercial fishing vessels. The AgFF sector does not include wildland fire fighting, which is part of the NORA Public Safety sector.

### **What are NORA Councils?**

Participation in NORA Councils is broad, including stakeholders from worker organizations, universities, large and small businesses, professional societies, and government agencies. Councils are co-chaired by one NIOSH representative and another member from outside 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.

### **Agriculture, Forestry and Fishing Council**

The AgFF Sector Council first met in 2007 to develop research priorities for the second decade of NORA, and has continued to meet regularly a few times per year since then. Members have come from industry and associations; government agencies such as the U.S. Coast Guard, the Occupational Safety and Health Administration, and state agencies; advocacy and non-governmental organizations; academia and research; and workers themselves. There are currently more than 70 members, representing 39 different organizations.

The mission of the Agriculture, Forestry, and Fishing (AgFF) Sector Council is to support the most important research, understand the most effective intervention strategies, and learn how to implement those strategies to achieve sustained improvements in workplace practice within this diverse sector.

### **What does the National Occupational Research Agenda for Agriculture, Forestry and Fishing represent?**

The National Occupational Research Agenda for Agriculture, Forestry and Fishing (AgFF) aims to identify the research, information, and actions most urgently needed to prevent occupational injuries and illnesses in the U.S. agriculture, forestry and fishing workforce. This Agenda provides a vehicle for stakeholders to describe the most relevant issues, gaps, and safety and health needs for the sector. Each NORA research agenda is meant to guide or promote high priority research efforts on a national level, conducted by various entities, including: government, higher education, and the private sector. Because this Agenda aims to guide national occupational health and safety research efforts for the Agriculture, Forestry and Fishing Sector towards concerted public health impact, it cannot 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 focused enough so that resources could be focused on a manageable set of objectives, thereby increasing the likelihood of real impact in the workplace.

NIOSH used the draft Agendas created by the sector and cross-sector NORA councils as an input into the development of a [NIOSH Strategic Plan](#). Programs used the [burden, need and impact method](#) to write 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?**

Agriculture, Forestry and Fishing is a diverse sector with a wide array of engaged stakeholders whose unique missions contribute to the safety and health of the sector's workforce. The target audiences for this Agenda are similarly varied, and reflect the Agenda's objectives.

In agriculture, the Agenda will encourage:

- researchers to continue to study the risk factors for, and the distributions of, injuries and diseases, as well as to develop effective interventions;
- employers, agri-business, public health and health care practitioners, policy makers, government agencies, industry associations, manufacturers and advocacy/worker organizations to translate effective interventions, and programs on farms and in farming communities; and

- agencies to continue supporting these efforts.

In fishing, this Agenda will guide efforts by the U.S. Coast Guard and other governmental entities as well as manufacturers, industry associations and fishermen to continue to develop, test, and translate engineering controls and other public health solutions for the most common industry safety hazards, and to encourage additional research into health-related risks.

In forestry, this Agenda will guide researchers and industry groups as they attempt to characterize the risk factors, adverse health and safety outcomes, and distributions of injuries and disease among forestry workers, and develop engineering controls and management interventions to mitigate them.

## How was the research agenda developed?

The Agenda was developed collaboratively, beginning with web-based meetings and conversation in late winter and extending into summer 2017. In preparation, efforts were made in late 2016 and early 2017 to announce the AgFF Sector Council and invite participation from a diverse group of representatives from the types of organizations listed above. An anonymous web-based survey was then distributed electronically (with Office of Management and Budget approval) to all Sector Council members asking them to prioritize various safety and health research issues in each subsector to provide a starting point for group discussions. The survey built on the goals and objectives from the previous decade of NORA (2006-2016), input from the Sector Council in 2014-2016 on emerging issues, and those that warranted being carried forward.

A web meeting was held for Sector Council participants interested in contributing to the fishing subsector in February 2017. A similar meeting was held for participants interested in agriculture and forestry in early March 2017. These meetings confirmed the survey results, provided additional detail about specific facets of interest or higher priority within the general categories enumerated on the survey, and elicited discussion about emerging and potential future issues for consideration. Notes from each of these meetings were used to craft and then refine a draft list of objectives, with background, examples and justifications for the identified priorities. The draft document was circulated among the Sector Council in May 2017, and feedback was again incorporated to prepare a draft for public comment. After considering public comments, the final version was published.

The agenda uses NIOSH's four types of occupational safety and health research as an organizing framework.

- **Basic/etiologic:** Builds a foundation of scientific knowledge upon which future interventions are based. Most laboratory research falls into this category, as well as exposure assessment.
- **Intervention:** Engages in the development, testing or evaluation of a solution to an occupational safety and health problem or the improvement of an existing intervention. Intervention is a broad term that includes engineering controls, personal protective equipment, training, and fact sheets and other written materials intended to inform and change behavior, among other occupational safety and health solutions.
- **Translation:** Discovers strategies to translate research findings and theoretical knowledge to implementable practices or technologies in the workplace. This type of research is needed when effective, evidence-based interventions are available but are not being adopted.
- **Surveillance:** Development of new surveillance methods, tools and analytical techniques. This is defined more narrowly than injury and illness surveillance, which routinely collects data on standard variables.

In addition to these four primary types of occupational safety and health research, the agenda in some places also calls for other types of research and activities. For example, workforce research to characterize the size and

demographics of working populations, and surveillance activities using new and established methods are needed to provide a foundation for safety and health research and intervention activities. Education, training, and intervention translation activities are needed where safety and health problems have been well-studied and solutions tested.

## THE OBJECTIVES

### Agriculture

#### **Objective AG-01. Reduce risk of fatal and nonfatal injuries to workers in the agriculture sub-sector.**

Farm machinery is a leading source of fatalities and injuries in agriculture accounting for 23–50% of fatalities and approximately 50% of hospitalizations from nonfatal injuries (Jawa et al., 2013). Animal related accidents are another main source of fatalities and injuries in agriculture (Browning, Westneat, Sanderson, & Reed, 2013). In 2014, the leading source of injuries for household working youth were vehicles while the leading source of injury for both household non-working youth and visitors were animals (NCCRAHS, 2016).

Although fatalities in agriculture production have decreased since the 1990s, the number of fatalities in agricultural confined spaces annually have fluctuated from 33 in 1992-1996, to 54 in 2010, to 31 in the 2010-2014 period. Grain entrapment and engulfment represent 50% of agricultural confined space incidents (Issa, Field, Schwab, Issa, & Nauman, 2017).

Research needed to prevent fatal and non-fatal injuries to workers in the agriculture subsector spans basic/etiologic research through translation research, depending on the specific injury risk under study. Specific sources of injuries for which research is a high priority in the agricultural sub-sector include:

- Motorized vehicles and heavy machinery, including all-terrain vehicles (ATVs), utility task vehicles (UTVs), and industrial vehicles
- Livestock
- Falls associated with working surfaces and work at heights
- Grain bins and augers
- Workplace violence, including human trafficking, bullying and sexual harassment (male and female)

Safety culture, work organization, and management, including leadership and systems safety approaches, are promising strategies for intervention and translation research in particular. For instance, findings from a study on heat related illness and farm worker healthcare suggest that prevention plans should be guided by strategies that integrate worker control with work-site organization and employer relations, instead of strategies that only focus on traditional modes of training to advance prevention (Courville, Wadsworth, & Schenker, 2016).

Focused efforts to conduct translation research to identify barriers to adoption and effective strategies to implement and scale up existing evidence-based injury prevention interventions across the subsector are needed. Economic evaluations of safety strategies, including the promotion of safety culture, may be key to expanding strategies of proven efficacy into workplaces.

**Emerging issues** relating to fatal and non-fatal injuries in agriculture include identifying and characterizing:

- Both hazards and promise for emerging technology such as automated/semi-automated vehicles, robotics, and unmanned aerial vehicles (drones).

- Hazards related to emerging and expanding agricultural practices, for example urban farming, marijuana farming, robotic farming, agritourism, and hydroponic/aquaponics.

### **Objective AG-02. Reduce the risk of work-related illnesses to workers in the agriculture sub-sector.**

Farmers and farmworkers are exposed to several environmental and occupational hazards. They are exposed to respiratory hazards including organic and inorganic dusts, gases in confined animal feeding operations, bacteria and endotoxins, nitrogen dioxide from silo gases and agrochemicals (e.g. pesticides, antibiotics) (Holguin & Schenker, 2017). Livestock farmers and farm workers have an increased risk of respiratory illnesses including chronic bronchitis, COPD and reduced lung function (Eduard, Pearce, & Douwes, 2009; May, Romberger, & Poole, 2012).

Their work encompasses the full range of identified musculoskeletal injury risk criteria including force, repetition, duration, posture, and metabolic factors. Several studies have shown increased risk of developing work-related musculoskeletal disorders among agricultural workers compared to other occupational groups (Holmberg, Stiernström, Thelin, & Svärdsudd, 2002; Morse, Warren, Dillon, & Diva, 2007). Annual prevalence of musculoskeletal symptoms among agricultural workers in the United States has been estimated between 40% and 73% (Lee, Tak, Alterman, & Calvert, 2014).

Farmworkers are at an increased risk of heat-related illness given that they spend several hours working outdoors (Kearney, Hu, Xu, Hall, & Balanay, 2016). They are also at risk for developing noise-induced hearing loss (Lie et al., 2016). Hazards for agricultural workers related to animal production include zoonoses and veterinary medications (LeJeune & Kersting, 2010).

Basic research should continue over the next decade to better describe and characterize hazardous exposures including chemical (e.g. pesticides), respiratory, physical, biological, ergonomic, and animal exposures. Basic research should also focus on associated adverse health outcomes including acute and chronic respiratory diseases, reproductive health, cancers, musculoskeletal disorders, noise induced hearing loss and zoonotic infections.

Intervention research is needed to develop and test efficacy of evidence-based interventions to mitigate hazardous exposures. Translation research is also needed to move the large body of evidence establishing causal relationships between health risks in agriculture and preventable work-related illnesses. The NIOSH [Total Worker Health®](#) (TWH) program is one promising strategy that recognizes multilevel interventions, integrating environmental, health, and safety policies with health promotion in the workplace. Research on how to effectively apply Total Worker Health® principles and tactics to agricultural workplaces and communities may be informative as a potential tool for research translation and implementation. Translation research, using TWH and other models, to inform transfer of research findings, technologies, and information into acceptable practices and effective products can advance health and well-being in the workplace, and prevent a variety of work-related diseases in the agriculture subsector.

New areas for research encompass studies to understand the health implications of emerging technologies and emerging agricultural industries. In addition, research on issues that have gained importance over the past decade, such as stress and mental health, alcohol abuse, drug use, suicide among farmers and farmworkers, and violence in the workplace should be expanded to better characterize the risks and the affected populations. Effective prevention and treatment solutions will help alleviate behavioral risk factors pertaining to safety, which can seriously affect an agricultural worker's focus while operating machinery even when he or she is aware of proper safety protocols.

### **Objective AG-03. Improve reporting and surveillance of injury and illness in the agriculture sub-sector.**

Exposure, injury, and illness monitoring is critical in this sector for prioritizing, planning, and evaluating research and practice investments, and for anticipating emerging needs. Agriculture is a diverse sub-sector with a great deal of regional and geographic variability. Understanding the ways in which exposure characteristics are distributed in agricultural populations requires novel and innovative surveillance strategies. Exploration of new occupational injury, illness, hazard, and exposure data collection approaches is of high priority. Existing surveillance data should be analyzed to produce estimates for specific regions, geographic areas, populations, exposures, or injury and disease outcomes. Standardization of injury coding and reporting, as well as improving occupational data in electronic health records, appears to be a promising avenue for surveillance that should continue to be pursued. Improved worker demographic information at the national and state level is also important for developing accurate estimates and implementing targeted interventions.

### **Objective AG-04. Reduce the risk of illnesses and injuries in vulnerable worker populations in the agriculture sub-sector.**

Vulnerable populations in the agriculture sub-sector include recent immigrants and foreign-born workers (who may be undocumented). Undocumented workers are known to make up a considerable proportion of the agricultural workforce and the AgFF sector workforce as a whole (Liebman et al., 2013; Quandt et al., 2013). Temporary workers are another vulnerable group who are often not adequately trained and lack workplace benefits (Foley, 2017).

Migrant workers typically have very little formal education and are extremely poor. More than 80% of migrant farmworkers in the U.S. are Latinos whose predominant language spoken is Spanish; however, there are growing numbers of workers who speak indigenous languages such as various Mayan dialects (Ramos, Su, Lander, & Rivera, 2015). Interventions must be culturally appropriate and tailored to the needs of these groups to be effective.

Other populations in the agriculture sub-sector with unique needs and challenges requiring targeted interventions are young workers, aging workers, farm women/women farmers, unpaid family workers, new farmers, physically and cognitively disabled workers, as well as agritourists and non-working children.

## **Forestry**

### **Objective FO-01. Reduce the risk of fatal and non-fatal injuries to workers in the forestry sub-sector.**

Logging workers had the highest fatal work injury rate with 132.7 fatalities per 100,000 workers in 2015 (BLS, 2015). In mechanized logging, the highest accident rate results from equipment maintenance and repairs and manual logging of remote areas. In semi-mechanized logging operations, the majority of accidents are often caused by chainsaws (Albizu-Uriónabarrenetxea, Tolosana-Esteban, & Roman-Jordan, 2013; Shaffer & Milburn, 1999). Falls and being struck by or against an object are main causes of injury in the logging process (Albizu-Uriónabarrenetxea et al., 2013; Quandt et al., 2013). Falls can occur when body parts are pinned between logs or equipment whereas struck by injuries can occur from falling trees branches, rolling logs, or kickback from power saws (Quandt et al., 2013).

Research on injuries is perhaps the most developed of the body of evidence in the forestry sub-sector. Basic/etiologic, workforce, and intervention research must continue on injuries resulting from:

- Physical hazards: noise, uneven ground, forest debris, obstructions, and extreme weather
- Motorized vehicles and heavy machinery, including ATVs, loading and transporting hazards



- Tools used for cutting and moving trees, felling, limbing, bucking, etc.
- Other safety hazards such as fire hazards and electric power lines

Surveillance research utilizing existing data to help identify hazards and injury trends or to establish new databases to collect information is much needed in this sub-sector.

Research to promote safety culture in forestry workplaces is a promising strategy that should continue to be pursued. Systems-based approaches as well as building capacity for effective, evidence-based training at all levels, including small business operations and new and experienced employees, need to be evaluated and effective interventions promoted in workplaces.

Emerging technology, and other innovative personal protective equipment, should be evaluated for safety of use in the forestry industry. Emerging technologies include:

- Steep slope logging technologies
- Use of unmanned aerial vehicles (drones)
- Tethered systems for steep slopes and autonomous heavy vehicles, and heavy machinery
- Wearable technology for hot environments

### **Objective FO-02. Reduce the risk of work-related illness to workers in the forestry sub-sector.**

Numerous health complaints by forestry and logging workers have resulted from work-related exposures to known ergonomic hazards, including machines with significant ergonomic deficiencies. In a study among logging machine operators in the southern U.S., 10.5% reported an musculoskeletal disorder diagnosis, 74.3% reported at least mild back pain, and 71.7% reported at least mild neck pain over the past year (Lynch, Smidt, Merrill, & Seseck, 2014). Research should be targeted to address health concerns among operators using imported forestry machines that may not have appropriate cabin space, position of controls, and/or machines stripped of safety and health features.

Other research priorities in forestry include worker exposures to noise, vibration, pesticides and toxic chemicals, and carbon monoxide in wildlands/forest fires. Future research should build a better understanding of the health implications of chronic diseases such as obesity and diabetes, and how they may interact with other exposures in the aging workforce. Emerging technology, particularly wearable technology and other innovative personal protective equipment should be evaluated.

Mental health, fatigue, stress, bullying/power imbalances, and substance abuse among foresters and loggers have been recognized in the forestry industry as worker safety and health issues that should be addressed. While the magnitude and distribution of these issues has yet to be documented through rigorous research, AgFF Sector Council members cited anecdotal evidence from personal experience that indicate that such research is needed. Research is needed to better understand these risk factors, particularly in relation to logging machinery operators and in the context of the stressful environmental conditions under which these operators work. Forestry and logging workers have disproportionately high rate of machinery-related fatal injuries (Marsh & Fosbroke, 2015). A variety of evaluation methods will be useful to address the many aspects of mental health in forestry and prevent injury in this sub-sector as a result.

### **Objective FO-03. Increase data meshing, information sharing, and collaboration among researchers in the forestry sub-sector.**

Collaborative research is needed address gaps in knowledge about health effects, health services, interventions, and regulatory policies relevant to future improvements in workplace safety of forestry and logging workers. New

and emerging research can best be identified through analyzing stakeholder needs, partner aims, and information exchanged in symposia and conferences. Surveillance data is an important tool for generating planning inputs for improving safety, which should be further developed into a robust system of local, regional, and/or national scope. Improved surveillance can assist more rigorous characterization of hazardous exposures such as chemicals, environmental, ergonomic, and biological hazards, and their safety and health impacts among forestry workers.

Top collaborative research priorities pertaining to logging and forestry include:

- Identifying factors that limit the adoption of safe practices and medical treatment of forestry and logging related injuries
- Building future capacity in safety and health for the forestry sub-sector via advanced occupational safety and health training programs
- Evaluating preventive interventions for the use of alcohol and illicit drugs by forestry workers
- Applying the latest developments in safety technology to improve the quality and availability of personal protective equipment (PPE) and equipment protection
- Developing an effective system-based approach for working with land managers to improve safety training, contracts and compliance with safety requirements.

#### **Objective FO-04. Reduce injuries and illness in vulnerable worker populations in the forestry sub-sector.**

Demographics of forestry workers show an aging workforce; the median age of logging workers in 2016 was 46 years, compared with 42 years for U.S. workers overall (BLS, 2017). Effective ergonomic interventions are needed particularly among older loggers and foresters to address increased risk in this sub-sector for musculoskeletal disorders such as repetitive strain injury (RSI) and cumulative trauma disorders (CTDs). Likewise, physical/cognitive disabilities and increased risk for fatalities among older workers are prime areas for research. Risks and prevention strategies specific to other vulnerable forestry worker populations, such as seasonal, young, temporary, foreign-born, women, and lone workers should also be explored, according to AgFF Sector Council members with relevant expertise and experience.

## **Fishing**

#### **Objective FI-01. Reduce the risk of fatal and non-fatal injuries in the commercial fishing sub-sector.**

Commercial fishing continues to be one of the most dangerous industries in the United States. During 2000–2015, an annual average of 42 deaths occurred (117 deaths per 100,000 workers over the period) (BLS, 2016b). Data from the Commercial Fishing Incident Database (a surveillance system managed by NIOSH) reveal that from 2000 through 2015, the majority of the deaths occurred after a vessel disaster (defined as a sinking, capsizing, or other event in which the crew was forced to abandon ship) or a fall overboard. However, the Gulf of Mexico fishing region had more fatalities caused by falls overboard than by vessel disasters (Lincoln & Lucas, 2010).

The body of evidence regarding fatal work-related injuries has become well-developed over the past two decades. Interventions to reduce the risk of injuries and fatalities due to vessel disasters and improve the survivability of crewmembers, including during falls overboard, are of high-priority. These interventions may address hazards such as: skiff-related fatalities, icing, capsizing, flooding, fire and explosions. Translation research to increase the use of personal flotation devices in the commercial fishing industry should continue. More research is needed to

understand the risk of injuries and fatalities to crewmembers during all phases of vessel operations, including transiting, fishing, processing, docking, and offloading.

**Objective FI-02. Reduce the risk of work-related illness to workers in the commercial fishing sub-sector.**

Research has shown that musculoskeletal disorders are common among workers in the fishing sub-sector as well (Bloswick & Dzigan, 2014). In a study conducted among commercial fishermen along the coast of North Carolina, 84% reported musculoskeletal symptoms for any region of the body in the previous 12 months. Thirty-nine percent of the U.S. fishermen that reported symptoms experienced them at a level sufficient to limit their work activity in the last year (Lipscomb et al., 2004). In a recent study among lobstermen of the Northeast U.S., one half of the respondents reported low back pain (Fulmer, Buchholz, Scribani, & Jenkins, 2017).

Besides ergonomic hazards, fishing workers are also exposed to environmental, biological hazards, such as extreme weather conditions, ultraviolet exposure, zoonotic and vector-borne diseases, and allergens. These exposures need to be better understood and characterized.

Mental health, stress, and substance abuse may be common among workers in the commercial fishing sub-sector, but more research is needed to understand the magnitude and risk factors (Kucera & McDonald, 2010). These stressors may also interact with chronic health conditions, fatigue, sleep disturbance due to work organization, and be compounded by workers' lack of insurance and lack of providers trained to serve fishermen. Research to explore these factors and develop interventions is needed.

**Objective FI-03. Increase safety and health data meshing, information sharing, and collaboration among fishing safety researchers for workers in the fishing sub-sector.**

There is need to improve reporting and surveillance of injury and illness in the fishing industry. Underreporting of musculoskeletal disorders and nonfatal injuries is an issue (Case, Bovbjerg, Lucas, Syron, & Kincl, 2015; Day, Lefkowitz, Marshall, & Hovinga, 2010; D. L. Lucas, L. D. Kincl, V. E. Bovbjerg, J. M. Lincoln, & A. J. Branscum, 2014; L. N. Syron, Lucas, Bovbjerg, Bethel, & Kincl, 2016). Fishermen may not seek treatment due to lack of insurance.. Research is needed to better understand and identify hazards related to emerging practices such as fish farming, aquaculture, and offshore fish processing.

Researchers and organizations are encouraged to engage in information sharing and collaboration nationally and internationally to increase data meshing between countries, states, regions and other industry sectors.

**Objective FI-04. Reduce injuries and illness in the vulnerable worker populations in the fishing sub-sector.**

There are several vulnerable populations within the fishing sub-sector that merit additional consideration in safety and health research. Immigrant workers and those new to fishing are key populations for tailoring of worker safety and health research and intervention. While increased risk among immigrant workers has begun to be documented (Garcia & De Castro, 2017), risk among new workers needs basic research to explore anecdotal evidence. Fishing industry workers overall are at increased vulnerability because of lack of access to healthcare due to cost and demands of the profession; barriers and solutions warrant exploration.

**Objective FI-05. Reduce the risk of illnesses and injuries in the seafood processing industry.**

During 2011 to 2014, seafood processing workers experienced the highest injury/illness rate of any maritime workers, with 6,286 injuries/illnesses per 100,000 workers (BLS, 2016a). Studies conducted in U.S. have identified traumatic injuries as an occupational safety issue (Anderson, Bonauto, & Adams, 2013; Garcia & De Castro, 2017; Devin L Lucas, Laurel D Kincl, Viktor E Bovbjerg, Jennifer M Lincoln, & Adam J Branscum, 2014; Laura N Syron, Kincl, Yang, Cain, & Smit, 2017). A study conducted on onboard vessels operating in Alaskan waters during 2001 to 2012 found that the two most frequent causes of injuries were workers being caught in running equipment and cut by slipping knives (Devin L Lucas et al., 2014).

Basic epidemiology and surveillance are needed to identify and reduce seafood processing vessel/facility hazards and musculoskeletal/ergonomic risks in seafood processing and to further develop research capacity and the research agenda for this group of workers.

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