

Preface

In 2008, the National Occupational Research Agenda (NORA) Agriculture, Forestry, and Fishing (AgFF) Sector Council released a national [Agriculture, Forestry and Fishing Agenda](#) to be used by researchers throughout the United States. This plan was to guide research projects to fill high-priority knowledge and action gaps. The Agenda lists goals and priorities for work-related safety and health research in the AgFF sector. With the development of new technologies, procedures, and surveillance over the decade, the NORA AgFF Sector Council perceived a need for revised goals and clarification of the Agenda. This document provides updates to the background and goals of the NORA AgFF Agenda.

The NORA AgFF Sector Council divided itself into working groups to address each of the nine Strategic Goals outlined in the Agenda:

- Surveillance
- Vulnerable Workers
- Outreach, Communications, and Partnerships
- Agriculture Safety
- Agriculture Health
- Forestry*
- Fishing*

*These working groups addressed Strategic Goals for both health and safety.

Over the past 4 years, working groups have met individually to review the Agenda and provide clarification and updates. Each working group had a designated leader who led discussions to reach consensus on any updates or additions.

The 2008 version of the Agenda divided the goals into three levels.

- **Strategic Goals** are the long-term goals that have effect on decreasing illness, injury, and exposure of workers.
- **Intermediate Goals** intend to produce research results that may lead to efforts to change policy, procedures, and actions toward the accomplishment of the Strategic Goals.
- **Action Step Goals** include research that leads to outputs such as research and trade publications, conference presentations, and outreach efforts.

The Action Step Goals can lead to Intermediate Goals being addressed, which in turn can lead to the accomplishment of the Strategic Goals. In this revision we have made changes and additions to only the Intermediate Goals and Action Step Goals.

Besides providing updates and revisions to the NORA AgFF goals, this document also provides indicators (grey text) of goals that have been addressed and completed, whether by NIOSH or its research partners. Information on the work NIOSH is doing to address the NORA AgFF Agenda can be found at the [NIOSH AgFF web site](#) and linked pages. NORA leadership is aware of many organizations that have or are currently working to address goals.

Further information and background on NORA can be found [here](#). Information specific to the NORA AgFF Sector Council can be found [here](#).

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Strategic Goal 1: Surveillance

Improve surveillance within the Agriculture, Forestry, and Fishing (AgFF) Sector to describe the nature, extent, and economic burden of occupational illnesses, injuries, and fatalities; occupational health hazards; and worker populations at risk for adverse health outcomes.

Public health surveillance is an essential part of any public health prevention program [Halperin 1992]. These data define which populations are at risk for injury or illnesses and assess the impact of intervention programs by tracking changes over time, while providing the means of identifying new and emerging health issues.

Ideally, AgFF surveillance systems would identify injury and illness events on an ongoing basis at the state and local level, such that trends could be tracked over time and new policies and interventions could be evaluated. Currently, injury and illness surveillance in the AgFF sector is sparse, and ongoing census activities at the state and federal level track only fatal injuries. Although surveys are used to supplement the system, non-fatal injuries and illnesses and illness-related deaths are not adequately tracked at this time [National Academy of Sciences 2007].

Progress has been made in some areas, such as injury surveillance for youth on farms and pesticide poisoning surveillance, but these advances have not been extended to cover other farm populations or outcomes [NIOSH 2006, 2008]. Information is limited on the numbers and types of workers at risk within this sector. The available surveillance data are not always readily accessible to those who need the data to take preventive actions [National Academy of Sciences 2007]. All these areas need major improvement if the occupational health of this sector is to be significantly improved.

At its core, the AgFF sector surveillance goal includes (a) improved occupational injury, illness, and hazard surveillance; (b) improved data on the sector work force; and (c) improved data accessibility for researchers and communities. The sector council recognizes that building an appropriate AgFF surveillance system is a long-term undertaking and that consideration must be given to laying the foundations for a surveillance system for the future as well as making the best use of currently available data.

Intermediate Goal 1.1

Maximize the use of existing surveillance resources in AgFF in the short-term to describe the nature, extent, and economic burden of occupational illnesses, injuries, and fatalities; occupational hazards; and worker populations at risk for adverse health outcomes.

Action Step Goals

1.1.1. Assemble a list of accessible datasets that pertain to occupational injury or illness in AgFF. Review and describe the content of these datasets in terms of included populations, injury and illness outcomes, and their frequency, severity, cost, preventability, communicability, and public interest.

1.1.2. Maintain, expand, and modify existing surveillance systems, including pesticide poisoning and childhood agricultural injury surveillance, to fill identified gaps and increase the utility of the data for prevention activities.

1.1.3. Explore new occupational injury, illness, hazard, and exposure data collection approaches (include pilot testing and evaluation) for agriculture, forestry, and fishing. Approaches may include medical surveillance methods, case-based surveillance methods, physician reporting methods, worksite assessment methods, or other methodologies. Priority should be given to understudied conditions (such as musculoskeletal conditions, hearing loss, respiratory diseases, and zoonoses), hazard assessments, and exposure assessments.

1.1.4. Maintain ongoing best available estimates of at-risk populations for agriculture, forestry, and fishing, with limitations and caveats explained. For production agriculture, this includes undocumented farmworkers, unpaid family members, and children residing on family farms.

1.1.5. Continue research into the feasibility of using hours at risk rather than total workforce population numbers since there are so many workers in this sector who work other than the typical 40 hour week.

1.1.6. Work with U.S. Department of Agriculture National Agricultural Statistics Service (USDA-NASS), the U.S. Bureau of the Census, National Safety Council, Agricultural Safety and Health Council of America, and Workers' Compensation insurance providers on assessing the feasibility of conducting occupational injury and illness surveillance within the forestry industry.

1.1.7. In collaboration with the U.S. Coast Guard, expand the NIOSH Commercial Fishing Injury Database (CFID) to all regions of the United States

1.1.8. Hold a national meeting of surveillance experts and stakeholders to assess the current status of AgFF health surveillance systems, to identify new approaches to conducting health surveillance for all AgFF sub-sectors, and to identify existing or new partners for conducting AgFF health surveillance (recommendation from the National Academy of Sciences [2007], NIOSH Agriculture Program Review Committee).

Intermediate Goal 1.2

Develop over time an effective national surveillance system for AgFF (in collaboration with other sectors).

Action Step Goals

1.2.1. Work with other NIOSH sectors toward increasing the use of occupation and industry coding in existing national databases to identify occupational injuries, illnesses, hazards, and exposures.

1.2.2. Advocate for resource allocation for industry studies of the AgFF sector to establish populations at risk. Improve worker demographic information at the national and state level by creating new systems to better characterize the workforce within each AgFF sub-sector.

1.2.3. Incorporate variables into existing or new surveillance systems to facilitate the identification of known vulnerable worker populations. For example, variables such as "native language" and "temporary worker status" make it possible to compare health outcomes among known vulnerable populations.

1.2.4. Improve comparability of research data over time by encouraging researchers to utilize terms, definitions, and categorical variables from the "Dictionary of Terms for Agricultural Safety & Health Professionals" 2008 NORA AgFF Agenda Appendix 2) in their surveillance systems.

1.2.5. Increase level of detail in occupational illness, injury, and fatality surveillance data in the AgFF sector, and make these data readily available to workers, employers, research scientists, and the public in a timely manner.

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Strategic Goal 2: Vulnerable Workers

Reduce deleterious health and safety outcomes in workers more susceptible to injury or illness due to circumstances limiting options for safeguarding their own safety and health.

Background

Some workers experience disproportionate rates of occupational injuries and illnesses within the AgFF Sector, because of social or physiological factors that can lead to increased workplace exposures and/or individual susceptibilities. For many workers, vulnerability is multifactorial and may change during their careers. Appropriate interventions and remedies require an understanding of the factors that increase and reduce vulnerability of workers in the AgFF Sector.

The Intersection of Surveillance and Vulnerability

Surveillance of work-related health conditions is an essential tool to inform and evaluate the design of control measures to prevent them. Though some specific surveillance systems exist for occupational causes (such as asthma and pesticide poisoning), most surveillance of occupational illness and injuries is collected through nonspecific systems, such as workers' compensation and the Bureau of Labor Statistics (BLS).

These systems are not designed specifically for occupational safety and health surveillance and therefore do not have representative coverage of all workers, workplaces, and geographic areas. In this sector, workers and workplaces in particular are often not well-covered by such systems. Worker compensation rules vary considerably from state to state. Worker compensation is not required, nor at times available, for all employers. Agriculture is often fully or partially exempted from worker compensation requirements. Federal regulation requires any employer with 11 or more employees to maintain OSHA work-related illness and injury logs, which are then reported to BLS and form the basis for the national-level occupational safety and health surveillance program. Many agricultural establishments have fewer than 11 employees and are therefore exempt from this requirement.

Workers in employment settings that are not covered by a workers' compensation program or who work for very small employers may be systematically excluded from surveillance. They also may be a high-risk or particularly vulnerable group of workers. Exclusion from surveillance makes planning and evaluating preventive measures more difficult. Risk increases when fewer are evaluated, effective prevention measures are not known and implemented.

Social Factors

Researchers recognize the effects of various social factors on health, for example, housing quality and affordability, English ability, literacy and numeracy, socioeconomic status, migration, discrimination, and temporary, seasonal, and precarious employment. These factors work through many mechanisms to influence worker health. Several of these factors increase vulnerability by compromising workers' ability to seek protections and/or access resources that others employed in this sector access. Though not the only workers experiencing the negative effects of so many of these factors, recent immigrant workers tend to be among the most vulnerable because they experience many of these effects simultaneously and over the life course.

Recent Immigrants

Recent immigrants may experience multiple factors contributing to their vulnerability, such as limited English, low literacy, low socioeconomic status (SES), lack of social support networks, and dire economic need. Foreign-born workers make up a large proportion of the AgFF workforce. Workers with undocumented immigration status make up one third of the foreign-born labor force [Kochhar 2008]. Although foreign-born workers are primarily from Latin America, the countries and regions of origin for this workforce are changing rapidly.

Demographic data are difficult to obtain for the forestry workforce (see 2008 NORA AgFF Agenda Appendix 1), but it is estimated to be heavily dependent on Latinos, Southeast Asians, and Eastern Europeans. Among agricultural workers, approximately 80% are foreign born, more than half are undocumented, and 87% are Latino, predominantly Mexican [Steege and Baron 2007]. Latino AgFF workers have experienced elevated and increasing occupational fatality rates every year since 1992. The Medical Expenditure Panel Survey found that Latinos experience higher rates of nonfatal lost-work-time injuries than do other AgFF workforce segments.

Their economic situation, the seasonal nature of much of the work, and the contingent work status of most Latino AgFF workers force many of them to change occupations within the sector and across sectors and to relocate themselves and their families (migration). These circumstances also make them less likely to challenge or to walk away from unsafe working conditions, the results of which are compounded by their lower rates of health insurance coverage. For these reasons, Latino workers are highlighted as Vulnerable Workers in Strategic Goal 2.

These conditions are not unique to Latino AgFF sector workers; other immigrant workers face similar challenges that may go unrecognized. Each of these circumstances leads to increased vulnerability because they may result in social and economic marginalization, isolating the worker from services (such as health care), resources (such as training), and protections available to AgFF workers overall.

Physiologic Factors

Physiologic factors such as age, gender, race/ethnicity, and underlying health conditions are important to consider when assessing vulnerability and risk. “Fatal occupational injury rates are higher in the agriculture, forestry, and fishing sector than the private sector for every age group. The rates ranged from 13.7/100,000 for workers aged 16–24 to 62.0 for workers older than 64” [BLS 2003].

With fewer legal restrictions, AgFF workers may start work at a younger age due to family connections or economic necessity, before they are physically or mentally prepared for hazardous work. On the other hand, the agriculture workforce overall is getting significantly older. Many farmers continue to work in spite of physical or mental limitations accumulated over time, which may accelerate the onset and severity of disabilities. Underlying health conditions, physical and cognitive disabilities, and medications can affect risk for work-related injury. Age, gender, and race/ethnicity all affect fit of respirators and other personal protective equipment (PPE), potentially putting some workers at greater risk than others even when they use the right PPE.

Women Farmers and Workers

Many women are engaged in agricultural work, often working in nurseries or greenhouses. Additionally, there has been an increase in the number of women working as principal operators of farms, particularly on organic farms (2007 Census of Agriculture). Although women are exposed to the same hazards and risks as male workers, they may have additional risks associated with their health. Women’s average size and strength can impact their ability to work safely on farm operations. The proper use of PPE can be influenced by finding appropriately sized equipment. Reduced strength and size may influence their ability to operate large machinery [McCoy et al. 2002].

Agricultural work involves strenuous activities and repetitive tasks that may put a pregnant woman at greater risk for injury [McCulloch 2002]. Exposure to pesticides has also been associated with increased adverse pregnancy outcomes, including infant mortality, low birth weight, and reduced fertility [Runkle et al. 2014]. In animal agriculture, where endocrinological pharmaceuticals are often used, pregnancies may be threatened by exposure [Wilkins & Bowman 1997; Weese & Jack 2008]. Women farmworkers are also at much higher risk of

experiencing sexual violence at work than their male counterparts, largely as a result of the intersection of being female and many of the social factors mentioned above [Oxfam America 2015].

Young Workers

Work tradition, economic need, and other circumstances lead to children working in family or community businesses. More than one million youth lived on farms in 2006, and more than half of them performed work or chores on the farm [NIOSH 2007; NIOSH 2004]. Hired workers younger than 18 years made up approximately 3% of the crop production workforce in 2003–2004 [Steege 2008]. For workers under 18 years of age, the AgFF industries have higher rates of fatal traumatic injuries than all industries [Hard and Myers 2006]. The physical and cognitive development and lack of experience of young workers make them more vulnerable to work-related injuries than their adult counterparts.

Older Workers

The average age of farmers is on the rise. In 1997 the average age of the principal farmer operator was 54 years, and it rose steadily to 58.3 by 2012, and almost one-third (32.5%) of farmers were 55 years of age or older [USDA 2014]. Farmers often work past the average age of retirement, as compared to other occupations. At a time of physical diminishment, such as reduced mobility, limited vision and hearing, and reduced reaction time, older farmers face increased vulnerability to injuries and illness and may continue to perform tasks beyond their ability to safely accomplish farmwork.

Older farmers have a higher rate of skin cancer, high blood pressure, and hearing problems than older workers in the general population [Hernandez-Peck 2001]. The nature of farmwork—such as jumping off farm equipment, riding on vibrating machinery, and constant bending—can aggravate age-related ergonomic issues. Arthritis affects approximately one third of all adult farm and ranch operators and is considered one of the leading causes of disability [AgrAbility 2008]. Older farmers are more likely to be hospitalized for farm-related injuries and are more likely to sustain permanently disabling or fatal injuries than younger farmers. Chronic health conditions may impair older farmers' ability to perform certain tasks and operate machinery safely [Marcum 2011].

As with all occupations, not only does biological and physical functioning decline as people age, but cognitive functioning may deteriorate, which can influence risk of injury. Older workers have been found to take longer to return to work following injury, illness, and disability.

Though demographic data are scarce for the fishing and forestry sectors, it is probable that they too are aging and experiencing the same conditions.

Physically and Cognitively Disabled Workers

Workers who are physically and cognitively disabled are at higher risk of occupational injury as a result of decreased ability to perform their job tasks and respond to nonroutine or emergency situations. According to Field [2007], "Approximately one in five of the farm and ranch population have a disability that restricts daily living or hinders completion of essential work-related tasks." The disabilities most frequently reported among these workers are musculoskeletal disorders, hearing impairment, cardiovascular diseases, and respiratory impairment [Field 2007].

Unpaid Family Workers

Work traditions and economic need can lead to family members of all ages working without pay for family or community businesses. The Trades Union Congress Commission on Vulnerable Employment [2007] describes the risk inherent in being an unpaid family worker:

“... Unpaid family workers are people ... undertaking unpaid work for a business they own or for a business that a relative owns. ... Not receiving a wage puts people at greater risk of exploitation – primarily because they have no agreed terms and conditions and are not entitled to even the most basic of legal employment protections.”

Although it is suggested that unpaid family workers are more prevalent in agriculture, employment on small fishing vessels does not require the contract protections seen on larger vessels. The forestry industry has little documentation on this category of vulnerable workers.

The USDA 2012 Census of Agriculture [2014] showed that over 1.5 million principal operators in the United States indicated their place of residence was on the farm they operate. Leshed, Håkansson, and Kaye [2014] reported that farm families intentionally embrace merging home and work. Often the home is located strategically near the agricultural worksite to improve accessibility to high-labor facilities or where there are high care demands associated with animal husbandry [Midwest Plan Service 1990]. Other reasons for having the home on the production site may likely include sheltering the home structure from taxation or the opportunity to hand over the farm to heirs [Hoppe & Banks 2010]. Estimates indicate that over 6,000 nonworking youth were injured on farms in 2012 [NIOSH 2013]. Children and nonpaid family members living on farms may be more vulnerable to an agriculture-related incident because of the co-location of the home and workplace on the agricultural production site and therefore the close proximity to worksite hazards [Sanderson et al. 2010]. Children and family members may be given chores to help out during periods of labor shortage or because of the perception that farmwork builds work ethic and a desire to return to the farm [Leshed et al. 2014; Sanderson et al. 2010].

The circumstances and characteristics leading to vulnerability are defined here to include extremes in age (under 18 and over 65 years), gender, limited English language and literacy, non-U.S. birth and length of time in the United States, sector fluidity and migration, socioeconomic status, authorization to live and/or work in the United States, ethnicity, culture, and physical or cognitive disability.

Intermediate Goal 2.1

Define and identify "vulnerable workers" in each sector—agriculture, forestry, and fishing.

This Intermediate Goal and the associated Action Step Goals reference the surveillance segment of this plan to provide for collection of population-based data about vulnerable workers.

Because of the range of characteristics that can lead to vulnerability, it is a challenge to define each condition in a way that allows measurement in the target population. Such definitions are necessary to allow comparison of survey data between sectors, industries, or population groups.

Action Step Goals

2.1.1. Draft and encourage use of a surveillance definition developed for vulnerable workers and/or those suffering health disparities, specific to agriculture/fishing/forestry in the work setting.

2.1.2. Enumerate vulnerable workers by location and characteristics to establish a baseline for identifying disparities in health outcomes in vulnerable workers.

Intermediate Goal 2.2

Identify the deleterious health and safety exposures and outcomes experienced by vulnerable workers in each sector—agriculture, forestry, and fishing.

With the vulnerable worker population defined, the next step is to acquire data on their health outcomes. This will establish the level of health and safety risks for this population and allow comparisons to other AgFF worker populations to ascertain any increase in risk for vulnerable workers.

Action Step Goals

2.2.1. Identify health and safety exposures and outcomes for each of the vulnerable worker groups that are not traditionally categorized as occupational but that substantially impact the work-life of that group.

Examples include accumulation of pesticides on clothing because of limited laundry facilities and health hazards from unsafe housing.

2.2.2. Monitor patterns and trends of excess morbidity and mortality for vulnerable workers.

Intermediate Goal 2.3

Improve data collection and existing databases to provide information on safety and health disparities among vulnerable workers.

Although preliminary data are often informative, they are rarely comprehensive. Continuing effort should be made to acquire other data sources and refine the characteristics of the parameters used, to better identify the vulnerable worker population. Characteristics of the target population's activities and lifestyle, such as mobility and migration, must be taken into consideration when locating additional data sources and determining outcome rates. Continual improvement should be made in data collection methods to expedite the process and ensure the most complete data sets achievable.

Action Step Goals

2.3.1. Seek new data collection mechanisms where gaps exist.

2.3.2. Incorporate variables into existing or new surveillance systems to facilitate the identification of vulnerable worker populations.

2.3.3. Promote the integration of environmental and occupational health elements in primary and emergency care health records to facilitate the identification of vulnerable workers and occupationally related exposures, injuries and diseases.

2.3.4. Establish data-sharing mechanisms among universities, government agencies, and community-based and non-governmental organizations.

2.3.5. Develop methods to track workers who are mobile geographically or across industries to be able to assess long-term health effects.

Intermediate Goal 2.4

Use innovative and proven communication, education, training, and marketing techniques to tailor workplace safety and health programs to be responsive to the unique needs of vulnerable workers.

Once the risks are determined, the data must be used to advise the stakeholders: clinicians, healthcare facilities, employers, worker support agencies, and the vulnerable workers themselves. The information should be communicated in a timely manner, before the affected population is no longer accessible or conditions change. Any information describing the risks, how to avoid or prevent them, and what action to take when exposed to a hazard should be provided in a language, literacy level, and medium (such as radio) that is accessible to the target audience. Developing partnerships and continued collaboration with industry and government agencies

and other stakeholders could ensure improved development and dissemination of materials and program interventions.

Action Step Goals

- 2.4.1.** Assess and describe existing materials and interventions that have been evaluated and shown to be effective to determine their suitability for different vulnerable worker populations.
- 2.4.2.** Determine effectiveness of existing interventions and educational materials that are tailored to address unique factors associated with vulnerability.
- 2.4.3.** Facilitate the development and evaluation of high quality and appropriate materials where gaps exist.
- 2.4.4.** Where gaps exist, conduct pilot studies and real-world testing of tailored interventions to support scale-up and large-scale implementation.
- 2.4.5.** Facilitate large-scale implementation and industry adoption of effective health and safety interventions tailored to address risk factors associated with vulnerability, through partnerships with industry leaders and others in agriculture, forestry, and fishing.

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Strategic Goal 3: Outreach, Communications, and Partnerships

Move proven health and safety strategies into agricultural, forestry, and fishing workplaces through the development of partnerships and collaborative efforts.

This goal sets out a course of action to disseminate evidence-based strategies to all those who have a stake in improving the health and safety of workers in the agriculture, forestry and fishing industries. **Outreach** is a necessary step to effectively implement the full NORA AgFF plan. Disseminating relevant interventions and promoting the adoption of best practices in the workplace can be best achieved through **partnerships** and collaborations. Proven approaches to worker health and safety for each of the sector industries should be identified and a wide variety of outreach and **communications** methods applied to assure that optimal health and safety are achieved. These best practices include but are not limited to new technologies and engineering controls; behavior change interventions; training; incentive programs; and guidelines and policy approaches.

Recently new technologies have increased options to implement outreach and communications efforts. Increased availability of the internet to provide information and training, mobile computing platforms with corresponding communication and training applications, and portability of communication equipment have all recently been shown to augment outreach and communication activities. These new technologies can be incorporated in many of the goals and action Step Goals below.

Intermediate Goal 3.1

Form collaborative efforts with key partners and stakeholders to:

- 1) Biennially assess current and emerging major occupational health and safety concerns and solutions**
- 2) Prioritize interventions for implementation**
- 3) Report on status of all ongoing collaborative efforts in outreach and communications and highlight some of the success stories**
- 4) Discuss innovative intervention opportunities.**

Assuring the implementation of best practices, techniques, and equipment that promote health and safety in these industries will require the “buy in” of as much of the sector as possible. One of the best ways to ensure broad-based support for the adoption of best practices is to have a strong group of partners and stakeholders involved. These partners must be encouraged to communicate their needs as well as be committed to promoting the adoption of the latest and best safety and health methods available to the agriculture, forestry and fishing industries.

Action Step Goals

3.1.1. Identify partners and stakeholders and ensure they are aware of the NORA AgFF purpose and plan. Stakeholders should include policy makers, federal and state agencies, safety and health researchers and practitioners, agribusiness, agricultural producers, union representatives, farm labor contractors, farmworker representatives, commercial fishermen, extension forestry services, youth-serving groups, community-based organizations, and national-level coalitions.

3.1.2. With partners, prioritize interventions for implementation in the agriculture, forestry, and fishing industries.

3.1.3. Convene a national state-of-the-science conference on agriculture, forestry, and fishing safety and health resources, interventions, program needs, and training issues. Use this conference to facilitate networking, program implementation, and improved training among a wide range of collaborators.

Intermediate Goal 3.2

Identify practical and proven occupational safety and health interventions, and then encourage new studies to meet needs where proven strategies do not exist.

It is critical that the best practices in agriculture, forestry, and fishing be identified and reassessed on a regular basis. Such best practices may include methods developed in the United States as well as by comparable industries in other countries.

Action Step Goals

3.2.1. Determine best methods to influence safety and health related behaviors of agricultural workers, loggers, and commercial fishermen. Methods should account for social, economic, cultural, and other factors affecting the adoption of best practices among workers and employers. Assessments of barriers, motivators, and ideal strategies should be undertaken by NIOSH Agricultural Research Centers, USDA, Cooperative Extension services, universities, and other partners with expertise to conduct relevant, valid studies.

3.2.2. Document and report proven interventions. Determine how and where a list and description of proven strategies should be maintained for easy access by stakeholders in the AgFF industries. The NIOSH Agricultural Research Centers and other relevant groups should participate in this process to identify strategies of national as well as regional relevance.

3.2.3. Identify gaps in health and safety best practices and methods. Encourage and facilitate studies and programs to meet industry needs for improved safety, including engineering, information technology, and policy approaches.

Intermediate Goal 3.3

Use innovative and proven communication, education, and social marketing techniques to influence knowledge, attitudes, and practices of agricultural workers, loggers, and commercial fishermen.

As best practices are identified, it will be crucial that they be implemented as rapidly and thoroughly as possible in order to improve the health and safety of the target groups in each industry. The methods of dissemination of best practices in each industry must be varied and innovative. Farmers, fishermen, loggers, and their employees are unlikely to change their behaviors as a result of a single input of information. Research has shown that education alone is not sufficient for preventing injuries or changing behaviors. The panoply of techniques known to influence positive behaviors and reduce hazards in the work setting must be used.

Action Step Goals

3.3.1. Facilitate implementation of evidence-based programs that are culturally, linguistically, and educationally appropriate for workers and employers.

3.3.2. Increase awareness and promote expanded application of best practices, materials, technologies, and policies via partners such as producer organizations, health and safety practitioners, regulatory personnel, vocational teachers, extension agents, insurers, clinicians, and others in positions to influence adoption of best practices.

3.3.3. Facilitate the development of public awareness and social marketing campaigns regarding high priority agriculture, forestry, and fishing safety and health issues.

3.3.4. Encourage and promote proven outreach initiatives targeted for high-risk populations, including children and bystanders in the work setting.

Intermediate Goal 3.4

Use innovative educational techniques and certification programs to improve the safety practices of agricultural workers, loggers, and commercial fishermen.

Developing and promoting best practices in the workplace may be enhanced through training and certification programs. Proven approaches to worker health and safety for each of the sector industries are more likely to be developed, tested, and implemented if accessible, affordable, and high-quality training (including certification) programs are available for the industries of agriculture, forestry, and fishing.

Certification programs that currently exist provide examples, such as (a) operation of tractors and equipment, including power take-offs (PTOs), guards, and shields, for 14- to 15-year-olds under the Hazardous Occupation Safety Training in Agriculture (HOSTA) program at USDA; and (b) pesticide handling for farmworkers and handlers under EPA's Worker Protection Standard. Examples of modules in forestry and logging that could be developed for certification include (a) felling and bucking (cross cutting) timber; b) operator training for machines such as log loaders; and (c) operator training for mechanized equipment such as harvesters and forwarders. Training modules in commercial fishing for potential development and certification could include (a) surviving a vessel sinking and (b) preventing falls overboard and slipping.

Action Step Goals

3.4.1. Assess current, and develop additional, training programs (including train-the-trainer programs), materials, incentives, and methods; regularly update training materials and programs to be culturally, linguistically, and educationally appropriate. Training should provide options for AgFF employers and employees, health and safety practitioners, regulatory personnel, vocational teachers, extension agents, and others.

3.4.2. Promote and facilitate worker safety and health training at agriculture, forestry, and fishing industry/association regional events and national conferences.

3.4.3. Provide occupational safety and health content and recommendations for graduate level curricula (such as for USDA graduate school courses) related to production and management training programs in agriculture, forestry, and fishing held across the United States.

3.4.4. Develop nationally recognized certification programs for occupational safety training and health protection for agriculture, forestry, and fishing workers.

3.4.5. Annually assess the training programs, materials, and methods; update and modify them based on injury surveillance data and participant impact measures.

Strategic Goal 4: Agriculture Safety

Reduce the number, rate, and severity of traumatic injuries and deaths involving hazards of production agriculture and support activities.

To address the high fatal and nonfatal injury risk, six intermediate goals are proposed to reduce the overall burden of injury among workers in the agricultural production sector.

The Working Group members also felt that study and review of the use of highly automated, semi-autonomous, and autonomously operated ground-based agricultural vehicles in the United States, while currently not

included in this document as an Action Step, would become warranted as technologies and applications developed. Working Group members also felt that at this initial phase, NIOSH and its agricultural partners should promote and facilitate prevention by design to reduce the potential for agricultural injuries.

Intermediate Goal 4.1

Reduce the number of fatalities due to overturns of tractors in agriculture by 50%, through the use of Roll-Over Protective Structures (ROPS) or similar technologies, by 2018.

Action Step Goals

4.1.1. Work to increase the number of older non-ROPS tractors retrofitted with ROPS and seatbelts or replaced by ROPS- and seatbelts-equipped tractors.

4.1.2. Bring awareness to the issue by conducting extensive outreach to production agriculture and get more tractor operators to use a tractor with ROPS and wear seatbelts on ROPS-equipped tractors. Outreach materials could include pamphlets, posters, and radio and TV ads. Establish rebate programs to encompass the entire nation, similar to recent efforts in New York and Virginia.

4.1.3. Improve surveillance: include economics, intervention cost-effectiveness, epidemiology, behavior, and other human factors, as well as engineering and technology.

4.1.4. Because ROPS are proven technology, more research should be done on determining barriers preventing farmers from retrofitting their tractors with ROPS, assessing which tractors are overturning, and identifying where fatalities are occurring.

4.1.5. Partnership groups and coalitions, essential to preventing tractor-related injuries and deaths, should be formed in each region or state to influence adoption of proven interventions (such as engineering, incentives, and policies). Partners should include, among others, government agencies, employer associations, labor representatives, tractor manufacturers, family farm representatives, farm cooperatives, insurance companies, universities, and NIOSH Agricultural Research Centers.

Intermediate Goal 4.2

Reduce the number and rate of fatalities in production agriculture and in support activities due to runovers by agricultural field and farmstead machinery by 50% by 2018 from 2006 baseline data.

Runovers are the second most common type of death associated with farm tractors in the United States, accounting for 759 deaths between 1992 and 2005 [NIOSH 2006]. An additional 240 runover deaths occurred during this time period, involving other types of machines [BLS 2008]. Nearly half of these runovers (485 deaths) involved the operator falling from and being run over by the moving equipment, followed by 270 deaths from being struck by rolling equipment not in normal use (such as due to brake failure, with no one on the equipment, or due to an individual bypass-starting a machine in gear). In addition, 244 pedestrians were struck by equipment during normal use [BLS 2008]. As with overturns, farmers and farmworkers over the age of 54 years account for a significant number (68%) of these runover deaths [Myers et al. 2007b; BLS 2008]. Youths younger than 16 years old and especially those younger than 5 years old are at high risk for being run over by tractors and other mobile farm equipment [Goldcamp et al. 2004].

Operators and others, including persons providing support services, can be run over by agricultural field or farmstead equipment. Equipment operators, for example, can be run over when they attempt to start or move such equipment from a position other than the recommended operator's station or in a manner contrary to equipment manufacturer recommendations. Operators may also be run over when they are near equipment

that continues to move or moves unexpectedly, whether or not the engine is running, or when they attempt to mount equipment that is in motion. In addition, terrain, obstacles, and other factors can contribute to an operator being run over after falling from the equipment operator's station.

Extra riders, including persons authorized to provide training or being trained, can also fall from, exit, or attempt to remount field or farmstead equipment and be run over by it. For example, an extra rider may fall from the fender of an open station tractor, through an operator enclosure doorway, from a platform, or from a host of other places not designed or intended to be occupied while the machine is moving. In addition, extra riders may approach unnoticed or attempt to mount or dismount machines before the equipment has been fully stopped and secured. In some instances a person exiting and assumed to have cleared the area can be run over when the operator resumes equipment operation. In other instances, riders can fall from work platforms not intended for riders but nonetheless used for monitoring or other diagnostic purposes.

A bystander or helper can become a runover victim in a variety of ways even when neither riding on nor attempting to mount or dismount the equipment. For example, a person assisting a tractor operator to position a tractor making a connection to an implement could be run over by the tractor or the implement. An unsuspecting bystander of any age could be run over in the swept area of a wide machine traveling or turning. An unseen person near or approaching a machine that is moving or put into motion could also become a runover fatality.

The following activities are proposed to meet this intermediate goal.

Action Step Goals

4.2.1. Collaborate with producer groups, trade and technical associations, and safety professionals to identify ways to protect operators, helpers, and bystanders (adults or children) exposed to risks of being run over by field or farmstead equipment by identifying runover-related problems addressable by technical solutions.

4.2.2. Evaluate studies associated with current runover prevention intervention technologies and develop improved solutions. Efforts should be made to identify persons, tasks, and risk factors associated with runover events, identify commonalities and differences among the types, and evaluate strategies to reduce exposure to being run over by field or farmstead equipment.

4.2.3. Identify the risk associated with two vulnerable populations, children and older farmers, regarding runovers.

4.2.4. Identify, evaluate, and investigate ways to improve the performance of sensors and systems for enhanced vision and human presence protection, interlock and lockout systems, Global Positioning Systems (GPS) for worker location and activity monitoring, and sensor technologies that could be applied in the production agriculture and service activity workplace as means to address runovers by field or farmstead equipment.

4.2.5. Evaluate the effectiveness of existing runover prevention intervention measures (including barriers, obstacles, and incentives) in use by production agriculture and support activity workers (such as equipment dealers); then expand awareness and use of existing, effective runover prevention intervention measures by farmers, ranchers, farmworkers, their families, and persons providing support services for production agriculture through relevant partnerships.

4.2.6. Document and report the effectiveness of engineering, educational training, and other runover prevention intervention measures translated into practice.

4.2.7. Based on evaluation results and injury/fatality surveillance data, raise awareness and influence use of runover prevention intervention by farmers, ranchers, farmworkers, their families, and persons providing support services for production agriculture.

4.2.8. Respond to the unique needs of an increasingly diverse workforce, not limited to accommodating persons with disabilities (hearing impairment, physical limitations, or otherwise), in terms of runover prevention strategies.

Intermediate Goal 4.3

Reduce the number and rate of fatalities in production agriculture and in support activities involving agricultural field and farmstead equipment, not covered in 4.1 and 4.2, by 25% by 2018.

Machinery and industrial vehicle deaths not associated with overturns or runovers accounted for 1,505 deaths between 1992 and 2005 [BLS 2008]. These deaths are more varied in nature but involve such events as being caught in running machinery (624 deaths), nonhighway transportation events excluding overturns and runovers (269 deaths), highway collisions between the farm equipment and other vehicles (154 deaths), being struck by falling parts of machinery (144 deaths), or equipment contacting electrical lines (72 deaths). As with the overturns and runovers, farmers and farmworkers over 54 years old account for more than half of these deaths (774 deaths), especially those involving other nonhighway transportation events, where older workers were the victims 71% of the time. To address these other machinery and industrial vehicle risks, the following activities are proposed.

Action Step Goals

4.3.1. Enhance/expand safety interventions with farmers and farm families, including resources such as safety videos, hazard identification kits, and best practices guidelines. Incorporate information regarding economic issues/benefits of maintaining a safe working environment (lost family income, medical costs, lawsuits and legal issues, and tax benefits).

4.3.2. Conduct studies to determine the most cost-effective and practical strategies for eliminating fatalities, including engineering design (such as sensors), information technology (such as GPS), incentive programs, and guidelines or policies.

4.3.3. Using available data, identify and report fatality trends and keystone issues, such as entanglements, operations (dropping, raising, swinging), electrocutions, slips, trips, falls, and collisions, associated with equipment-related deaths.

4.3.4. With partners in agricultural production and support activities, promote and implement those interventions and materials. These interventions and materials are to be distributed by partner organizations.

4.3.5. Establish a national standard for lighting and marking for farm equipment. [completed]

Intermediate Goal 4.4

Reduce the number, rate, and severity of nonfatal injuries (OSHA-recordable type) in production agriculture and in support activities involving agricultural field and farmstead equipment by 25% by 2018.

Data from NIOSH estimate an average of 93,000 nonfatal OSHA-recordable injuries occurred on U.S. farms during the years 2001 and 2004 [NIOSH 2006]. Machinery (such as balers, mowers, augers, and combines) and industrial vehicles (such as farm tractors and forklifts) accounted for 12% of these injuries [NIOSH 2008]. Machinery accounted for 7,400 injuries, whereas industrial vehicles caused 4,000 injuries. For machinery-related injuries, the highest portion (38%) involved getting caught in running equipment, followed by being struck by the

machine or parts of the machine (26%). For industrial vehicles, half the injuries involved off-road vehicle incidents, which included overturns and falls from running equipment. Unlike fatal injuries associated with machines and industrial vehicles, most nonfatal injuries occur to farmers and farmworkers younger than 55 years old (65%). However, workers over the age of 54 years accounted for 45% of industrial vehicle injuries. To reduce these nonfatal machinery and industrial vehicle injuries by 25% over the next 10 years, the following activities are proposed.

Action Step Goals

- 4.4.1.** Work with and encourage the development of new, and the enhancement of existing, surveillance systems with agricultural organizations, workers' compensation carriers, other interested parties, and both federal and state agencies.
- 4.4.2.** Assess existing educational materials for accuracy, relevance, and usability for target audiences.
- 4.4.3.** Ensure educational materials incorporate economic issues/benefits of maintaining a safe working environment (lost family income, medical costs, lawsuits and legal issues, and tax benefits) and proven strategies for the most common equipment-related injuries.
- 4.4.4.** Facilitate dissemination of these materials through partner organizations and various distribution mechanisms (refer to Strategic Goal 3).
- 4.4.5.** Conduct research to identify innovative strategies, other than traditional educational approaches, for reducing the rate of nonfatal equipment-related injuries. Interventions to be tested should address engineering design, information technology, incentive programs, and policies.

Intermediate Goal 4.5

Reduce the number, rate, and severity of nonfatal injuries (OSHA recordable type) and the number and rate of fatalities in production agriculture and support activities not covered in 4.1, 4.2, 4.3 and 4.4 by 25% by 2018. Examples: livestock, tools, buildings, bins, and structures.

Non-machinery causes of deaths accounted for 3,479 fatalities in production agriculture between 1992 and 2005. These fatal agricultural injuries involved trucks associated with highway transportation events (743 deaths), working surfaces associated with falls (345 deaths), animals (317 deaths), and ammunition associated with assaults and self-inflicted injuries (249 deaths) [BLS 2008]. Farmers and farmworkers over the age of 54 years account for approximately 63% of the animal-related deaths reported in agriculture [Hard et al. 2002; BLS 2008]. For the annual 93,000 nonfatal OSHA recordable injuries that occur on farms, an average estimated by NIOSH, the most common sources of injury were identified as working surfaces associated with falls (22%), animals (19%), and hand tools (8%) [NIOSH 2008]. Nearly three-quarters of these nonfatal injuries occur to workers younger than 55 years old, with this age group accounting for just over three quarters of the animal-related injuries and 65% of the working surface-related injuries associated with falls. To address this broad range of fatal and nonfatal risks, the following activities are proposed.

Action Step Goals

- 4.5.1.** Work with and provide additional resources to USDA-NASS and state governments to conduct injury surveillance to provide state-level data that identify and describe the nature and extent of nonfatal work-related injury according to the preferred categorical variables in the Dictionary of Terms for AgFF Professionals.
- 4.5.2.** Analyze data from USDA-NASS, NIOSH, and refereed journals to determine major causes of nonfatal agricultural work-related injuries and to identify effective strategies that could prevent these injuries.

4.5.3. Encourage collaboration with USDA, NIOSH, the Agricultural Safety and Health Council of America (ASHCA) (www.ashca.org), and other similar partners to create and enhance financial resources available to reduce nonfatal work-related injury.

4.5.4. Work with the NIOSH Agricultural Research Centers, Cooperative Extension safety specialists, Farm Bureau safety leaders, and others to identify effective, research-based intervention programs for nonfatal work-related injury for application at national, state, county, and community levels.

4.5.5. Work with ASHCA, ISASH, NIOSH Agricultural Research Centers, Cooperative Extension safety specialists, Farm Bureau safety leaders, producer organizations, and others to promote and implement safety education, intervention programs, and recommended guidelines/policies for nonfatal work-related injury (refer to Strategic Goal 3).

4.5.6. Work with ASHCA, major farm organizations, agribusiness, and the farm media to influence farmers' and the public's perspectives on the value of working to better manage hazards and risks among workers and bystanders in agricultural occupational settings (refer to Strategic Goal 3).

4.5.7. Identify best methods, practices, and interventions for protecting nonworkers from hazards in and around production agriculture and support activities.

Intermediate Goal 4.6

Study and review the use of unmanned aerial vehicles (drones) in agriculture in the United States to determine what hazards they present to workers. Conduct surveillance on the hazards associated with their use and develop and evaluate controls for the hazards identified; implement prevention through design).

Action Step Goal

4.6.1. Establish professional relationships between agricultural safety organizations, the Federal Aviation Administration, and other relevant organizations in regards to unmanned aerial vehicle safety issues.

Strategic Goal 5: Agriculture Health

Improve the health and well-being of agricultural workers by reducing occupational causes or contributing factors to acute and chronic illness and disease.

Agricultural workers face an exceptionally wide range of acute and chronic health exposures at work. Agricultural work is hard work; it involves long hours under difficult conditions and repetitive exposure to musculoskeletal strains and sprains, respiratory hazards, toxic chemicals, psychological stresses, and a variety of zoonotic diseases. These problems have been recognized by the agricultural health and safety community for some time. Many of the salient issues, clearly identified in the groundbreaking report *Agriculture at Risk: A Report to the Nation*, remain a concern [Merchant et al. 1989]. Additionally, emerging concerns associated with new production methods, environmental issues, technologies, and changing demographics of the workforce warrant attention.

With respect to limitations in agricultural occupational surveillance data, the 1989 report by Merchant et al. noted that “These statistics... ignore the wide range of agriculturally related diseases that have been documented in several epidemiologic studies, but for which adequate state or national statistics are not available.” Although some data are available, such as estimates of national occupational pesticide-related illnesses, the data collection challenge remains a problem and is addressed throughout this document.

Note: For Goal 5, target dates were excluded because baseline data from which to measure change are not yet available.

Action Step Goal

5.0. Develop, test, and continually improve surveillance systems to document incidence and prevalence of disease outcomes associated with agricultural work.

The five intermediate goals are not meant to be all inclusive but represent recommendations of the Council regarding priority issues.

Intermediate Goal 5.1

Reduce the incidence and prevalence of musculoskeletal disorders (MSD) associated with work practices and production agriculture.

Among available general industry data sources (BLS, National Safety Council, Liberty Mutual Annual Workplace Safety Index), strains and sprains consistently comprise the largest share of the most frequent cause of workplace injuries and illnesses. It is generally agreed that “while there is not good national data on the extent of these injuries and illnesses either within agriculture or relative to other industries, there is growing evidence that this problem likely exceeds all other types of injury and disease in the agricultural industry” [Chapman and Myers 2001]. Agricultural work encompasses the full range of identified musculoskeletal injury risk criteria, including force, repetition, duration, posture, and metabolic factors. Helpful research and successful intervention projects have been initiated on a modest scale in some industry segments, such as the nursery and wine industries, but significantly more is needed [Janowitz et al. 1998; Meyers et al. 2006].

Action Step Goals

5.1.1. Conduct continued research on MSD risk factors as they relate to workers in the agricultural sector.

5.1.2. Conduct research on alternative methods to accomplish tasks with high incident rates of MSD.

5.1.3. Develop, test, and widely promote best practice models and guidelines for MSD prevention in specific agricultural operations.

5.1.4. Conduct research on MSD injury recovery and return to work in an agricultural setting that provides guidelines to health care providers, injured workers, and employers.

5.1.5. Continue research into and development and validation of MSD exposure assessment tools as well as the etiology of MSDs.

5.1.6. Improve utilization of the NIOSH Agricultural Research Centers, Education and Research Centers (ERCs), and other partners to address regional work and environmental hazards that cause unique illness and disease conditions that can be rectified in the future by research and program interventions.

Intermediate Goal 5.2

Reduce acute and chronic respiratory disease caused or exacerbated by agricultural exposures, including asthma, chronic obstructive pulmonary disease, and interstitial and infectious diseases.

A wide range of respiratory diseases have been associated with exposures in agriculture [Schenker 1998]. These diseases include effects on the upper respiratory tract, the airways, and the pulmonary interstitium. In addition, exposures to biologic agents (bacteria, viruses, and fungi) in agricultural processes may result in respiratory infections. Upper respiratory tract effects include inflammation of the mucous membranes in the nasopharynx and sinuses. Airway disorders cover a wide range of diseases, including upper airway irritation, asthma and asthma-like syndrome, toxic tracheobronchitis, and chronic airflow obstruction. Interstitial diseases include fibrosis, organic dust toxic syndrome, and hypersensitivity pneumonitis. A contributing risk factor is that agricultural work is associated with very high exposures to respiratory toxicants, often orders of magnitude higher than in other occupational settings [Doekes et al. 1998]. Epidemiologic studies have documented increased respiratory morbidity and mortality in a wide range of agricultural settings. This is of particular concern because cigarette smoking prevalence is lower among farmers and farmworkers than in the general population [NIOSH 2013]. A challenge to reducing respiratory disease in agriculture is that farmers do not believe their risk to be increased, and use of respiratory protection is limited [Schenker et al. 2002]. As with many hazards in agriculture, specific risks vary greatly with the climate, geographic region, and agricultural practices. For example, hypersensitivity pneumonitis is a greater risk in regions with increased moisture, which is conducive to mold growth. Conversely, dry climate farming in the western states has a greater risk for dust-induced airflow obstruction and restrictive lung disease. Some respiratory diseases such as tuberculosis may be increased among immigrant farmworkers, but dissemination may be associated with agricultural practices and/or housing conditions [Ciesielski et al. 1991].

Action Step Goals

5.2.1. Provide outreach and education to employers and the employees on the hazards to which they could be exposed and proven strategies and interventions for exposure control.

5.2.2. Conduct research on facility and equipment design and other engineering modifications that can reduce employee exposure to respiratory disease-causing agents.

5.2.3. Conduct continued research on chronic respiratory disease and its effects on agricultural workers, giving attention to the synergistic effect of occupational and nonoccupational risk factors.

5.2.4. Develop and improve methods for assessment of exposures and better characterization of pathophysiological disorders.

5.2.5. Conduct research on how to best develop respiratory protection programs for rural communities and on best practices for providers of these programs and services.

5.2.6. Improve utilization of the NIOSH Agricultural Centers and ERCs to address regional work and environmental hazards that cause unique illness and disease conditions that can be rectified in the future by research, outreach, and education.

Intermediate Goal 5.3

Reduce acute and chronic illnesses associated with exposure to pesticides and other agrochemicals.

Pesticides are a diverse group of chemicals in terms of their toxicity, modes of action, and uses. Broadly, pesticides include insecticides, herbicides, fungicides, fumigants, growth regulators, miticides, algacides, biopesticides, and rodenticides. The pesticide landscape is steadily changing as chemicals move off the market while others move in. For many decades, pesticides have been an integral part of crop and animal production. They have also been used in forestry to control insects and diseases and have emerged in commercial fish farming. Workers in the agriculture, forestry, and fishing sector are also exposed to other agrochemicals, such as fertilizers and adjuvants.

Historically, the effects of acute pesticide exposure were initially described, especially the effects from acute exposure to organophosphorus (OP) and carbamate acetylcholinesterase-inhibiting pesticides. Ongoing work is needed to track the magnitude of these acute effects, to identify emerging pesticide problems, and to evaluate efforts to mitigate acute pesticide-related health effects. More recently, the effects of chronic pesticide exposure, as well as the delayed effects of acute pesticide exposure, are becoming better understood. Chronic exposure to certain pesticides has been associated in some epidemiological studies with certain cancers (such as non-Hodgkin's lymphoma; prostate, colon, and bladder cancer; multiple myeloma; and leukemia), with respiratory disease (allergic asthma) and respiratory symptoms (such as wheeze), with certain neurological conditions and disorders (such as Parkinson's, depression, cognitive dysfunction, and organophosphate-induced delayed neurotoxicity), with retinal degeneration, and with hearing loss [Alavanja et al. 2004; Kirkhorn and Schenker 2002; Richter and Chlamtac 2002; Dich et al. 1997; Zahm et al. 1997; Maroni and Fait 1993]. Ongoing or additional research is needed to confirm these associations and to understand the biological mechanisms of action, utilizing appropriate in vitro human systems, human cell lines, human primary cells, and humanized transgenic animal models. Human metabolism studies, using genotyped samples with polymorphisms, can also reveal the extent of variation within the population, thereby improving human health risk assessment. Certain pesticides have also shown reproductive or developmental effects in animals; however, human data are limited [Iyer 2001]. Less understood is the effect of co-exposure to multiple pesticides, which may dramatically alter the metabolism and/or elimination of pesticides and enhance pesticide toxicity. Interactions between pesticides and endogenous metabolites such as steroid hormones may have important human health implications. Finally, as the working population ages, attention will need to be focused to better understand how agrochemical exposures might interact with the prescription drug intake of older workers. These workers may also experience different recovery responses to acute or chronic exposures.

Exposure monitoring, pesticide poisoning surveillance, and epidemiological studies have been used to varying degrees to describe the extent of pesticide exposure, morbidity, and mortality, primarily in agriculture [Kasner et al. 2012; Curwin et al. 2005b; Alavanja et al. 2004; Hines et al. 2003; Kirkhorn and Schenker 2002]. Workers exposed to pesticides include farmers, ranchers, commercial pesticide applicators, horticultural workers, tree nursery workers, forestry workers, hired agricultural workers, crop advisors, and commercial fish farmers. The families (spouses and children) of AgFF workers may also be exposed to agricultural pesticides, either as a result of the close proximity of the home and work environment or through pesticides carried home on the clothes

and equipment of the workers [Curwin et al. 2005, 2007; Bradman et al. 1997; Fenske et al. 2000; Loewenherz et al. 1997; Simcox et al. 1995]. Methods to assess pesticide exposure include environmental measurement of pesticides in air and dermal samples, qualitative and quantitative fluorescent tracer techniques, and biological monitoring. These techniques have generally required significant laboratory facilities. More rapid, but still reliable, in-field assays would be desirable. The wide-ranging chemistry of pesticides and their metabolites, together with the continual introduction of new pesticides, poses a challenge for developing exposure monitoring tools. Since personal protective equipment (PPE) is one of the primary methods of reducing pesticide exposure among handlers, indirect methods of assessing pesticide exposure must include assessing the extent to which pesticide applicators use correct PPE practices.

As exposure and health studies identify determinants of pesticide exposure and exposure pathways among AgFF populations, research to evaluate interventions for reducing exposure will be needed. These interventions might focus on equipment modifications, work practice changes, PPE use, hygiene practices, culturally and language-appropriate training and education materials, and risk perceptions.

Action Step Goals

5.3.1. Improve the organization of existing information. Based on an evaluation of findings, develop and implement biological monitoring guidelines, such as cholinesterase testing.

5.3.2. Develop and distribute pesticide education materials that can be easily understood by all workers, including foreign-born workers, reflecting language and cultural differences.

5.3.3. Test and evaluate interventions that lead to implementation of best practices and behavioral change related to protection from chemical exposures.

5.3.4. Develop and improve methods for assessment of exposures to agrochemicals, including interactions of multiple chemicals found in the workplace.

5.3.5. Improve utilization of the NIOSH Agricultural Research Centers, ERCs, and other partners to address regional work and environmental hazards that cause unique illness and disease conditions that can be rectified in the future by research and program interventions.

5.3.6. Conduct research to assess the health effects of occupational exposures to pesticides and other agrochemicals on men, women, and children.

Intermediate Goal 5.4

Reduce illness and disease due to physical and infectious exposures in agriculture such as ultraviolet radiation, heat and cold, noise, and zoonotic diseases.

Farmworkers are exposed to a wide variety of environmental hazards, chemical exposures, biological agents, and physical agents (noise, heat, cold, vibration, ultraviolet light, etc.). Farmworkers undertake many work situations: traditional crop and livestock production, machinery repair, welding, and chemical application. The hours of outdoor work common in many agricultural settings often result in intense exposures to ultraviolet radiation and dermatologic health outcomes such as skin cancer. Exposures to noise and vibration are a common occurrence in agriculture through exposure to a range of farm machinery and animal confinement operations. Studies document that noise-induced hearing loss can accompany these exposures in farmers. Agricultural tasks often involve close work with many different types of domestic animals, providing opportunity for the manifestation of zoonotic diseases through contact with diseased animals or their body fluids, aerosols from contaminated agricultural settings, or needlestick injuries. Brucellosis, leptospirosis, tuberculosis, and avian or swine influenza are some examples of zoonotic diseases and exposure hazards among agricultural workers.

It is difficult to quantify the illness and disease status of workers on American farms in relation to environmental exposures. The Bureau of Labor Statistics gathers statistics on agricultural injury and fatalities, but these provide only a partial picture of the hazards faced by farmers. Occupational illness is common in agriculture. However, documenting an exposure and its health effect is often difficult because of the long latency period (years) between exposure and health outcome. Better surveillance is needed to determine the extent of these diseases and evaluate their reduction by interventions.

Action Step Goals

5.4.1. Establish systems to more efficiently access currently available data and acquire new data on exposure and health outcomes associated with environmental, physical agent, and infectious agricultural conditions.

5.4.2. Augment current research associated with animal-related diseases or zoonosis, such as but not limited to avian influenza, bovine tuberculosis, and other emerging issues such as agroterrorism. Exposure assessment, prevention, vaccination, and treatment all need to be included in the research.

5.4.3. Test and evaluate interventions that lead to the implementation of best practices and behavioral change related to environmental, physical agent, and infectious exposures.

5.4.4. Develop methods of exposure evaluation as well as ongoing research into the characterization of the pathophysiology of these illnesses.

5.4.5. Increase involvement of the NIOSH Agricultural Research Centers and ERCs to address regional work and environmental hazards associated with unique illness and disease conditions that can be rectified in the future by research and program interventions.

Intermediate Goal 5.5

Develop and promote adoption of effective interventions to enhance psychological well-being of workers and to minimize the adverse effects of stressful agricultural working conditions (such as economic forces, weather, and isolation).

Psychological stress is typically a product of overwork or conflicting or competing demands on the job. Inadequate time to complete a task can create anxiety and stress that then challenge the ability of workers to cope with the job demands. As this high level of demand continues over many hours or days, fatigue accumulates along with the stress; then farmers and farmworkers are less able to attend to the hazardous conditions in their work environments. The cumulative impact of psychological stressors can lead to conditions of acute stress in the short term and chronic strain over the long term. Changing weather conditions provide an excellent example of circumstances where the agricultural worker has no control over the forces of nature but is nevertheless responsible for maintaining the agricultural operations.

The experience of the U.S. farm crisis of the 1980s has been replicated around the world. An economic recession in the United States which followed a period of high inflation resulted in some farmers owing more money than their entire operations were then worth. In the language of agricultural economics, the debt-to-asset ratio on some U.S. farms rose above 1.0. One consequence of this crisis is that the suicide rate (from confirmed suicides) of principal owner/operators of farms climbed to approximately four times that of other rural residents, including other farm family members [Gunderson et al. 1993]. (The actual rate of suicides among principal owner/operators in the United States is almost certainly much higher because of the stigma associated with suicide, as well as possible loss of any insurance benefits.) The continuing stress and worry associated with these economic problems resulted in the loss of many family farms, marital breakups, and as noted, many suicides.

The combination of stress and fatigue has both short- and long-term consequences [Kidd, Scharf, and Veazie, 1996]. In the short term, stress and fatigue can result in lack of attention to changing hazards, which can lead to poor decision-making by the farmer or farmworker. In the long term, prolonged stress can lead to chronic strain, depression, deterioration of societal functioning, and even suicide. Furthermore, in considering the psychological health and stressors in agricultural work as they concern the individual, it is important to examine the ripple effect on interpersonal relationships within rural societies and farm and farmworker families.

More research is needed to examine family, domestic, and sexual violence as an adverse effect of stressful agricultural working conditions.

Action Step Goals

5.5.1. Develop a surveillance system to help qualify the types and extent of psychological disorders experienced by agricultural workers. Use those findings to develop research priorities.

5.5.2. Conduct targeted research on factors associated with psychological disorders, especially as they relate to specific regional concerns or patterns.

5.5.3. Develop, implement, and evaluate culturally appropriate educational and outreach programs for promoting psychological well-being of agricultural producers, farms workers, and their families. Involve agricultural workers in their development and delivery.

Intermediate Goal 5.6

Develop and create mechanisms to get industrial hygienists and safety professionals onto agricultural worksites to identify, evaluate, and control or eliminate occupational health and safety hazards of exposed farmworkers.

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Strategic Goal 6: Forestry Safety

Reduce the number, rate, and severity of traumatic injuries and deaths involving hazards of forestry.

The enumeration of workers in the forestry workforce varies according to who does the counting. The numbers also may depend on states and how important forestry is to the economy of each state agency making the count. National counts aggregating state numbers or census data may not show the complete picture. For example, until 2001 (2003 in practice) logging was included in Standard Industrial Classification (SIC) code 241, and forestry tracts and services were included in SIC in 2008. The current North American Industrial Classification Standard (NAICS) moved the forestry workforce, in part, into the Natural Resources sector grouping of Agriculture, Forestry and Fishing. Previously, logging was associated with milling forest products and partially covered by the Census of Manufacturing periodically. There are persistent vagaries about which jurisdictional agency is primarily responsible for the safety and health of the forestry workforce. The Census of Agriculture covers farms and farmers and enumerates forestry products but not workers.

Reporting of acute, traumatic deaths and severe injuries related to commercial logging, although of not yet fully determined completeness, appears to be stronger than is the detection of related chronic injuries and illnesses. However, establishing the true causes of injury events is often not possible because of the method by which data are collected and investigations are conducted. In states with good data on logging and forestry services, the rates of fatalities, disability claims, occupations, exposure events, nature of injuries, and source of injury provide the basis for interventions and tracking of progress trends (Information Management Division, Oregon Department of Consumer & Business Services, October 2007).

For more information on this industry, see NORA AgFF Agenda 2008, Appendix 1, The Forestry Workforce, Statistics, and Organizations.

In order to develop performance measures and track improvements in safety and health and in working conditions, baseline data are needed. Since valid information is difficult to ascertain, the first goal is to improve injury and fatality surveillance options for the forestry sector. Refer to Strategic Goal 1 for a description of the surveillance goals and Action Step Goals.

Intermediate Goal 6.1

Reduce logging-related deaths, traumatic injuries, and exposures through collection and analysis of injury data and evidence-based safety improvements. Over time, reductions of 50% seem possible based on comparison with international injury and fatality rates for forestry and logging.

Action Step Goals

- 6.1.1.** Support ongoing improvements in data collection of forestry workforce subsectors (logging, forestry services, etc.) and associated illness/injury data collection.
- 6.1.2.** Assess the adequacy of fatality and injury reporting by type of logging (such as manual vs. mechanized logging, worker job category, full-time vs. part-time workers) for determination of optimal injury prevention strategies.
- 6.1.3.** Use available data, research findings, program results, and other evidence of outcomes to identify cost-effective, practical approaches to safe forestry practices.
- 6.1.4.** Determine what approaches or studies might be needed to fill gaps in information needed for developing and testing new interventions, including engineering, information technology, guidelines, and policies. Implement trials for improved data collection and review potential for improvements.

6.1.5. Determine the impact of solitary work conditions and remote locations on fatality rates in order to design effective countermeasures (more specific first-aid training, better communication devices, location/navigation aids for first responders). Technologies like SPOT® provide low-cost location and satellite communication for remote workers.

Intermediate Goal 6.2

Assess current federal and state forestry safety codes and voluntary consensus standards (such as OSHA, ISO, Federal Forest Activities, and state laws) for their coverage, and provide guidance to update them to maximize adoption of practices that minimize logging and forestry hazards.

Action Step Goals

6.2.1. Review 1994 OSHA logging standards at the federal level for currency and adequacy, using industry, state agency, and cooperative review. For example, AgFF researchers could collaborate with OSHA and a National Logging Committee composed of experts, state OSHA agencies, etc., to review the standards.

6.2.2. Review currency of state logging codes, plans for updating, and processes used within three years. For example, forestry researchers could help organize regional OSHA offices, state OSHA agencies, and industries to stimulate updating of current state logging codes.

6.2.3. Review Federal Safety Standards for coverage of forestry services activities.

6.2.4. Assist states in code revisions with research results and methodologies and model standards/approaches.

6.2.5. Provide recommendations for a revised Federal OSHA Code for Logging.

6.2.6. Prepare a model standard for forestry services at the federal level.

6.2.7. Provide a draft Federal OSHA Code for forestry services.

Intermediate Goal 6.3

Identify factors (such as risk-taking behaviors, workers' compensation vs. self-insurance) that limit the adoption of safe logging practices and the treatment of logging-related injuries, and propose interventions to address these factors.

Establishing cause and effect for forestry accidents can be difficult. Some injury investigations by state and federal organizations are not able to show specific causes. Comprehensive investigations of injuries and fatalities by competent forestry specialists with knowledge of equipment, conditions, and procedures would be helpful. The population of seriously disabled forestry workers might provide essential information on the actual cause of the injury after legal issues are resolved and workers' compensation issues settled, and if disabled workers are providing information anonymously. There is a need to better understand risk-taking behaviors of forestry workers.

Action Step Goals

6.3.1. Assess populations of seriously disabled forestry workers, via legal and ethical interviews, to understand circumstances of the injury event that can be reported in a manner that maintains worker anonymity.

6.3.2. Conduct trial regional studies (interviews), using interviewers with knowledge of the forestry industry, to assess disabled workers' circumstances of injuries.

6.3.3. Develop models of risk-taking behaviors with testable hypotheses and assess models with research and data.

6.3.4. Develop, implement, and evaluate interventions designed to reduce risk-taking behaviors among forestry workers and employers.

Intermediate Goal 6.4

Establish a Forestry Sector Partnership to develop new technologies (such as synthetic rope, “smart” clothing) that reduce workloads and injury risks associated with logging and forest operations.

Action Step Goals

6.4.1. Establish partnerships between the forestry sector and NIOSH researchers and cooperators to reduce workloads in the sector. For example, NIOSH and the AgFF Council could support and participate in a “Future of the Forestry Workforce Conference” with sector leaders to establish working relationships with forestry researchers and Extension Forestry faculty to disseminate results.

6.4.2. Establish a working group for future occupational safety and health research in the forestry subsector.

6.4.3. Conduct trials with technologies (such as synthetic rope to replace wire rope) in logging and trucking to document workload reductions and establish best practices guidelines and/or policies.

6.4.4. Review the use of powered hand tools in steep terrain to build fire trails and assess use of modified logging equipment to fight wildland fires for safety and health improvements. For example, NIOSH could work with the U.S. Forest Service Equipment Development Centers to reduce workloads in wildland firefighting.

6.4.5. Review technologies that reduce workloads (such as radio-controlled chokers, robotic functions, and autonomous systems for harvesting) and conduct trials for documenting gains; establish best practices guidelines and/or policies.

Intermediate Goal 6.5

Build future capacity in safety and health for the forestry sector via advanced training programs.

The advancement of injury prevention principles in the forestry and logging sector will require a continuous influx of safety professionals dedicated to building our knowledge base and modifying recommendations as production methods change. Strategic Goal 3 addresses advanced training and certification needs. Specific requests for the forestry sector are noted here.

Action Step Goals

6.5.1. Establish a mechanism of supporting research capacity of forestry sector research partners and for graduate students from the forestry sector to conduct safety and health research in cooperation with NIOSH.

6.5.2. Produce a Forestry Safety and Health web-based curriculum with materials adapted for U.S. regions that introduces undergraduate forestry students to safety and health concepts. Build support and connections to future forestry sector leaders. Request government funding, with a university taking lead for development and production of the curriculum.

Intermediate Goal 6.6

Reduce forestry-related deaths and traumatic injuries, with improved worker protection, through improvements in PPE and equipment design.

Action Step Goals

- 6.6.1.** Utilize incident data to prioritize hazards for traumatic injury to identify where PPE or equipment design improvements will be most effective. Use tools like risk analysis to evaluate equipment hazards. Communicate this information to users, researchers, and manufacturers to help direct efforts to develop safer operations and equipment. Use outlets like Forest Resources Association Safety Alerts to share information about known hazards.
- 6.6.2.** Support research to evaluate effective design of PPE and equipment operator protection. Safety development research should not be conducted in proprietary settings where findings have limited publication. Encourage federal research labs and university consortia to become engaged in this work by communicating value of research through program review and evaluation opportunities. Identify a list of research groups that can be used to communicate funding opportunities.
- 6.6.3.** Engage in standards development work to insure current safety practice and design are represented in products. This happens at state, national, and international levels. Identify a point of contact for each body responsible for logging safety standards. Communicate with this list about the most recent developments in PPE and equipment design standards. Maintain a liaison to get updates on current standards work.
- 6.6.4.** Review safety hard hats for improvements (such as head and neck protection during falls) that can be applied during hot weather conditions.
- 6.6.5.** Develop eye protection that is effective in both sun and rain conditions.
- 6.6.6.** Develop PPE for hand application of chemicals that is effective in varying forestry environments.

Strategic Goal 7: Forestry Health

Improve the health and well-being of forestry workers by reducing occupational causes or contributing factors to acute and chronic illness and disease.

Forestry workers face health risks related to the arduous jobs they perform, often in inclement weather and for long work shifts. Resulting musculoskeletal diseases and illnesses are often present in workers and may shorten working lives. Exposures to hazards and toxic materials require protective clothing and equipment. Use of drugs (whether prescription, recreational, and illegal) and alcohol is raised as a major concern among forestry workers. The complete health status of workers is not known but has likely changed with mechanization.

Scant data are available regarding forestry workers, their occupational exposures, and the disease outcomes associated with work. Without valid data, it is impossible to establish performance measures or track improvements in health status in the sector. Thus, the first priority will be to establish surveillance systems to gather and continuously improve data. Refer to Strategic Goal 1 for a description of the surveillance goals and Action Step Goals.

Intermediate Goal 7.1

Develop and implement interventions to minimize the frequency and causes of work-related musculoskeletal diseases (MSDs) and other acute and chronic illnesses leading to premature disability.

Action Step Goals

7.1.1. Assess tree planting operations for possible mechanization and means to reduce workloads causing muscle strain, such as delivering trees to planters in steep terrain.

7.1.2. Compare and contrast mechanized harvesting operations versus manual systems for health effects.

7.1.3. Review technologies that reduce workloads, such as radio-controlled chokers, robotic functions, and autonomous systems for harvesting, to reduce MSDs and other negative health effects. For example, research documentation is needed to show how efforts to reduce workloads result in fewer diseases and illnesses, with the long-term goal of maintaining the working lives of people.

Intermediate Goal 7.2

Developments in technology have the potential to monitor worker physiology in research and applied settings. This is especially important for safety and health in tasks with very high physical demands (e.g., choker setting, rigging, felling, and tree planting). Developments could come from research partnerships with forestry researchers within universities, U.S. Forest Service research units, and NIOSH research units.

Action Step Goals

7.2.1. Assign a NIOSH and forestry sector team to continue and monitor developments in this research area, at the NIOSH National Personal Protective Technology Laboratory (NIOSH-NPPTL).

7.2.2. Assess potentials of “smart clothing” currently used in other sectors (such as sports, military) for use in logging and forestry services to provide feedback and data on workers during operations and worker status on tasks.

7.2.3. Implement trials of “smart clothing” in the forestry sector to collect workload data (such as heart rate) and worker status (such as heat stress); then facilitate adoption of effective, practical interventions.

7.2.4. Continue research on inhalation hazards, including dust, and respirators for use in wildland firefighting, and assess exposure to smoke for wildland firefighters. Develop a complete product certification standard for respirators. **RETIRED: Wildland Firefighting goals are now part of the NORA Public Safety sector.**

Intermediate Goal 7.3

Evaluate the frequency of, impact of, and possible interventions for the use of alcohol and illicit prescription or other drugs by forestry workers, especially as it pertains to transportation of workers and products.

Action Step Goals

7.3.1. Assess current data sets on forestry worker injuries and fatalities for drug involvement to determine if recordkeeping provides basis for assessment.

7.3.2. Modify recordkeeping procedures consistent with legal and ethical guidelines to provide data for future assessments.

7.3.3. In states where “medical use” of cannabis is allowed, assess the extent of legal and illegal use by forestry workers. Provide assessments of other drug use (such as methamphetamines) on the job.

7.3.4. Assess current methodologies available to employers and improve them for field testing of workers for drug impairment.

7.3.5. Develop strategies for eliminating “perceived” need for drug use on the job. For example, strategies might address wake/rest cycles, alert/warning devices, workload reduction, and rest/refreshment breaks.

Intermediate Goal 7.4

Assess the health conditions of forestry workers to improve work design and work practices for workers entering the sector and those at later career stages.

Action Step Goals

7.4.1. Conduct preliminary health screening of workers entering the workforce for mechanized logging, manual logging, tree planting, wildland firefighting, etc.

7.4.2. Explore adoption of Total Worker Health strategies for forestry and logging workforce. Researchers may establish baseline data on the health and wellness of the forestry workforce and determine the impact of health promotion and wellness activities on the incidence of occupational illnesses and injuries in forestry and logging. Several factors, including worker status (part-time, seasonal, vulnerable, etc.), age, and occupation, could be important in determining the impact.

7.4.3. Assess health conditions of workers and work demands at selected career points and by occupation in logging, forestry services, etc.

7.4.4. Assess health conditions of workers over age 45 in forestry for health conditions that will affect continuing in the same occupation or that will need review for work modifications in their future.

7.4.5. Assess design improvements to work arrangements to address worker health conditions by occupation in logging, forestry services, etc. For example, health screenings may suggest worker pre-conditions for illness or disease that adjustments in work practices can help alleviate.

7.4.6. Assess interventions to worker health conditions related to work demands in logging, forestry, etc.

Strategic Goal 8: Fishing Safety

Reduce the number, rate, and severity of traumatic injuries (including deaths) involving hazards of commercial fishing.

Commercial fishing remains one of the most hazardous occupations in America. Despite reductions in fatalities since passage of the Commercial Fishing Industry Vessel Safety Act of 1988, commercial fishermen remain over 30 times more likely to die pursuing their occupation than the average worker in America. According to the Bureau of Labor Statistics [U.S. Department of Labor 2012] the fatality rate for the commercial fishing sector in 2011 was 121 per 100,000 workers. This compares to the national average of 3.5 per 100,000 workers, making commercial fishing the most dangerous occupation in America. During 2000–2012, 624 commercial fishermen died in the United States, an average of 48 per year. Vessel disasters caused 317 fatalities (51%), and another 191 (31%) were due to falls overboard. The remainder of the fatalities were due to onboard injuries (69; 11%), diving injuries (28; 5%), and onshore injuries (19; 3%) [NIOSH 2013].

The impact of the high rate of death and injury on fishing communities and fishermen's families is severe. The independent culture of those within the fishing industry and the limited safety and health regulations combine to create an environment where high-risk practices may be accepted as part of the job. Working conditions on board fishing vessels include a working platform exposed to the elements of weather in some extremely harsh conditions and which is continually in motion, most frequently wet, and reliant upon heavy machinery. Fishermen endure these conditions for extended periods of time, adding fatigue as a significant safety issue. Exacerbating this situation, some of the industry is overcapitalized, and competition for a tightly controlled resource adds competitive pressure that supports risk taking.

We have outlined the NORA Strategic Goals focusing on the commercial fishing industry to address the highest safety and health priorities.

According to an analysis by NIOSH [2013], 51% of fatalities in the commercial fishing industry are attributed to catastrophic vessel disasters in which the crews were forced to abandon ship. Another 31% of the fatalities were due to falls overboard. Drowning due to vessel disasters and falls overboard account for over three-quarters of all fatalities, making water exposure by far the most significant factor in worker deaths. Current safety regulations are focused on mitigating adverse events rather than preventing them, for example, keeping fishermen warm and afloat as they wait for rescue vs. preventing the vessel from sinking. Mitigating these events has resulted in measurable decreases in fatalities.

Many injury solutions have focused on education and other outreach efforts and should continue. Some notable examples of the positive impact of ensuring compliance with regulations and aggressive education have resulted in notable improvements in fatality rates, such as the pre-season boarding program with the crab fleet in Western Alaska [Lincoln et al. 2007]. The Intermediate Goals 8.1 and 8.2 address the most significant causes of fatalities.

Intermediate Goal 8.1

Reduce the vessel sinking and fatality rate due to vessel sinking by 50% by 2018.

Action Step Goals

8.1.1. Identify the fishery-specific hazards across the country for vessel sinking and subsequent fatalities. [Completed] Apply risk-management techniques.

8.1.2. Develop tailored interventions for the highest-risk fisheries to reduce injury and fatality rates by half. Such interventions may include pre-season safety checks similar to the ones conducted in Western Alaska.

- 8.1.3. Evaluate whether safety training reduces the fatality rate of commercial fishermen involved in vessel sinking.
- 8.1.4. Evaluate the effects that fisheries management practices have on safety in 6 different fisheries in the United States.
- 8.1.5. Develop a Top 10 list of fisheries management practices that contribute to unsafe practices in the commercial fishing industry. [completed]
- 8.1.6. Determine the cost effectiveness and benefits of safety training in reducing the rate of fatalities.
- 8.1.7. Determine the benefits of self-inspection of fishing vessels in reducing maintenance-related vessel sinking.
- 8.1.8. Determine factors affecting the risk-taking behaviors of fishermen that lead to vessel sinking.
- 8.1.9. Determine the benefits of stability training in reducing vessel capsizing and sinking.

Intermediate Goal 8.2

Reduce fatal falls overboard events and rates by 50% by 2018.

Action Step Goals

- 8.2.1. Develop and evaluate best practices for preventing falls overboard and fatalities due to falls overboard. These would include activities such as field evaluations of Personal Flotation Devices (PFDs), surveys of fishermen, developing better recovery devices and practices, and ways to prevent the fall in the first place.
- 8.2.2. Publicize best practices and recommendations for preventing falls overboard and reducing fatalities due to falls overboard.

Intermediate Goal 8.3

Understand and reduce the number, rate, and severity of hospitalized injury rates by 50% by 2018.

Action Step Goals

- 8.3.1. Identify data sources to analyze and determine high-risk operations leading to serious nonfatal injuries by fishery (see Action Step 1.2.6 for the Commercial Fishing Injury Database and Action Step 1.3.5 for the Census of Fatal Occupational Injuries).
- 8.3.2. Develop regional or fishery-specific interventions to address highest-risk operations for serious nonfatal injuries.
- 8.3.3. Complete fishery-specific outreach plans to share best practices for high-risk operations (see Action Step 3.3.2 for best methods of communication).

Intermediate Goal 8.4

Make commercial fishing vessel safety an interagency effort/priority.

Intermediate Goal 8.4 addresses this secondary contributing factor to casualties: fisheries management decisions that may unintentionally require unnecessary risk taking, penalize operators for safety-related decisions, or otherwise place a higher priority on fisheries issues at the sake of safety concerns. This is especially germane as fisheries management decisions place additional restrictions on commercial fishing to the point that

many fisheries cannot support the number of operators permitted in those fisheries. This recommendation stems from a study of fishing vessel safety sponsored by the U.S. Coast Guard [1999].

Action Step Goals

8.4.1. Develop a Memorandum of Agreement among NIOSH, National Marine Fisheries Service (NMFS), OSHA, and the Coast Guard on cooperation in improving commercial fishing safety.

8.4.2. Form a National Fisheries Management and Safety Coordination Committee to coordinate national policy integrating fishery management and safety regimes. [completed]

8.4.3. Through the National Fisheries Management and Safety Coordination Committee, develop specific guidelines for fisheries managers to use when assessing the potential safety issues that a proposed or current fisheries plan contains (such as overcapitalization, human resource issues, and economic pressures).

Strategic Goal 9: Fishing Health

Improve the health of commercial fishermen by reducing occupational causes or contributing factors to illness and disease.

Commercial fishing workers face an exceptionally wide range of acute and chronic health exposures at work. However, little research has been completed in regard to these health issues or their prevention. Commercial fishing is hard physical labor that involves long hours under difficult conditions and repetitive exposure to musculoskeletal strains and sprains, physical factors such as noise, psychological stresses, and toxic chemicals.

There is also no surveillance system or reporting requirement for health hazards present in the commercial fishing industry. The data collection challenge remains a problem and is addressed throughout this document. The three intermediate goals are not meant to be all inclusive but represent decisions of the Council regarding priority attention.

Intermediate Goal 9.1

Measure and reduce work-related musculoskeletal disease (MSD) due to acute and chronic exposures and ergonomic factors.

Action Step Goals

- 9.1.1. Conduct continued research on MSD risk factors as they relate to commercial fishing workers.
- 9.1.2. Conduct research on safe alternative methods to accomplish tasks with high incident rates of MSD.
- 9.1.3. Develop best practice models for MSD prevention in specific fishing operations.
- 9.1.4. Conduct research on MSD injury recovery and return to work in a commercial fishing setting that provides guidelines to health care providers, injured workers, and employers.
- 9.1.5. Develop and distribute guidelines for prevention of musculoskeletal injuries specific to the commercial fishing subsector.
- 9.1.6. Continue research into and development and validation of MSD exposure assessment tools as well as the etiology of MSDs.
- 9.1.7. Investigate potential sources of epidemiological data relating to rates and severities of musculoskeletal injuries in commercial fishing.
- 9.1.8. Investigate literature relating to MSD risk factors (and combinations of risk factors) specific to the commercial fishing industry. These factors include cold temperatures, moving work surfaces, slippery work surfaces, extreme fatigue, poor lighting, foot-line entanglement when moving the feet, etc.

Intermediate Goal 9.2

Measure and reduce illnesses and disease due to exposures to physical factors such as noise, cold, heat, and ultraviolet radiation.

Action Step Goals

- 9.2.1. Conduct continued research on exposures and related disease/injury rates to physical factors such as noise, cold, heat, and ultraviolet radiation.
- 9.2.2. Test and evaluate interventions that lead to implementation of best practices and behavioral change.

Intermediate Goal 9.3

Measure and reduce acute and chronic illnesses due to exposures (such as biological organisms, chemicals, particulate matter).

Action Step Goals

9.3.1. Conduct continued research on exposures and related disease rates to other exposures such as biological organisms, chemicals, and particulate matter.

9.3.2. Test and evaluate interventions that lead to implementation of best practices and behavioral change.

Special Note on Fatigue

Given the complexities of vessel operations, a systematic approach to fatigue mitigation and prevention is widely considered to be the most effective approach to manage the adverse effects of fatigue on the performance of vessel personnel. The fundamental parameters of such an approach include (1) proper scheduling and effective hours of service rules, (2) operator education, and (3) diagnosis and treatment of sleep disorders.

Rules governing rest and duty periods for some classes of commercial vessels limit work hours (hours of service) so that individuals have a minimum of 10 hours of rest within any 24-hour period. On a tanker, a licensed individual or seaman may not be permitted to work more than 15 hours in any 24-hour period or more than 36 hours in any 72-hour period, except in an emergency or a drill. International standards applicable to commercial vessels require most to have 77 hours in any week for rest. In addition, most commercial vessels have requirements for minimum crew size to ensure adequate crew to prevent fatigue.

For another class of commercial vessels without rules on service hours, uninspected towing vessels, the Coast Guard addressed the issue of operator education with its voluntary Crew Endurance Management System (CEMS). This program identified practices and methods to reduce crew fatigue that companies could use.

Licensed individuals are required to undergo periodic physical examination to determine medical suitability for service. Included are tools for medical personnel to alert them to risk factors for identifying sleep disorders. Sleep disorders that are discovered must be adequately addressed, as a precursor to obtaining a license.

By contrast, within the commercial fishing industry, unlicensed crew members are entitled to a share of the proceeds of the catch rather than a wage; compensation is a direct function of productivity and crew size. This encourages smaller crew sizes. Additionally, there is no incentive to fish fewer hours since compensation is based on the catch size. Therefore, most vessels/fishermen operate for extended periods, with minimal crew that have not been screened for medical suitability and with no exposure to methods of crew fatigue mitigation. It is easy to see that the risk of fatigue within the commercial fishing industry has not been addressed. To the contrary, exhaustive work for extended times is a measure of success and is the cultural norm.

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