NIOSH EXTRAMURAL RESEARCH AND TRAINING PROGRAM

ANNUAL REPORT OF FISCAL YEAR 2014

Prepared by the Office of Extramural Programs | National Institute for Occupational Safety and Health

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
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Sarah A. Felknor, DrPH; Peter Grandillo, MBA; and Viji Potula, PhD

DEPARTMENT OF HEALTH AND HUMAN SERVICES
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FOREWORD

I am pleased to deliver the FY2014 annual report of activity of the extramural research and training program of NIOSH. These data reflect the exceptional work of the extramural community of researchers supported by NIOSH and the Office of Extramural Programs.

This report details the investment NIOSH made during the fiscal year to our multidisciplinary centers, investigator-initiated research projects, and cooperative research agreements. Funding is also described for our training project grants, state surveillance programs, small business innovation research, and global health initiatives. This report does not include data on the grants program associated with the World Trade Center Health Program.

An analysis of funding and activity is provided by NORA program area along with a review of integrated research activity for each of the NORA sector strategic goals. Hyperlinks to the NIOSH website have been embedded throughout the report, providing instant access to additional, relevant data and information. The appendices provide additional data on the highlights of FY2014 and include a summary of the public health relevance and impact of our extramural portfolio.

I would like to acknowledge the work of the scientific program officials of the Office of Extramural Programs in compiling this report, along with the contributions of our summer interns Kristopher Brown and Janessa Aneke from Project IMHOTEP, an 11-week summer internship supported by a cooperative agreement between Morehouse College's Public Health Sciences Institute and the Centers for Disease Control and Prevention that is designed to increase the number of undergraduate students entering into graduate programs, and ultimately careers in public health.

We hope this report will help inform the ongoing discussion of how extramural research at NIOSH can help the Institute meet its research priorities and further the development of research integration activities across the Institute. Your feedback and suggestions are encouraged.

John Howard, M.D.
Director, National Institute for
Occupational Safety and Health
Centers for Disease Control and Prevention

EXECUTIVE SUMMARY

In FY2014, NIOSH awarded $97,708,126 in extramural funding, an increase of $3.2 million over the previous year. A total of 188 awards were made during the fiscal year, and the success rate for investigator-initiated research grants was 17%.

Multidisciplinary centers received a total of $53,295,102 (55%) and 33 awards in the following program areas:

- $26.9 million for 18 Education and Research Centers (ERCs).
- $15.8 million for 10 Agriculture Safety and Health Centers (Ag Centers).
- $5.7 million for 1 National Center for Construction Research and Training.
- $4.7 million for 4 Centers of Excellence to Promote a Healthier Workforce.

Investigator-initiated and career development research received a total of $28,914,609 (30%) and 88 awards. Cooperative research agreements made up $9,238,150 (9%) of the extramural portfolio, with 35 awards. Individual training project grants received a total of $5,292,701 (5%) with 30 awards, and $967,564 (1%) for 2 small business innovation research projects.

In FY2014, NIOSH extramural researchers reported 532 peer-reviewed publications in 237 journals. Publications increased 63% over FY2013 with 334 publications in 152 journals. ERCs reported the largest number of publications in FY2014 (215), followed by investigator-initiated R01 research (133). The journal most frequently published in by NIOSH researchers was the American Journal of Industrial Medicine.

NIOSH's global health initiatives supported the Global Plan of Action on Workers' Health (GPA) through a cooperative agreement with the World Health Organization (WHO) to leverage the capacities of WHO to implement key actions under the GPA by strengthening the capacities of national health systems to respond to the specific health needs of workers.

NIOSH continued its long-standing support of global occupational health research and training through its co-sponsorship of the National Institutes of Health (NIH) Fogarty International Center Global Environmental and Occupational Health Hubs planning grants to identify global need for research and training to address the most pressing environmental and occupational health issues around the world.

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LIST OF ABBREVIATIONS

Sector Programs

ALL	All Sectors or Multiple Sectors
AgFF	Agriculture, Forestry, and Fishing
CON	Construction
HSA	Healthcare and Social Assistance
MNF	Manufacturing
MIN	Mining
MIO	Oil and Gas Extraction
SPS	Public Safety
SRV	Services
WRT	Wholesale and Retail Trade
TWU	Transportation, Warehousing and Utilities

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I. NIOSH EXTRAMURAL RESEARCH AND TRAINING PORTFOLIO

The NIOSH Extramural Research and Training Programs represent a diverse portfolio of multidisciplinary research and training centers, investigator-initiated research, mentored research scientist development awards, training project grants, and small business innovation research projects in occupational safety and health. State surveillance programs and global occupational health initiatives complement the breadth and depth of extramural research and training at NIOSH. A description of these programs can be found at the Research and Training Portfolio webpage. Extramural funding opportunity announcements are published in the NIH Guide for Grants and Contracts, and are also available under "Funding Opportunities" on the NIOSH Extramural Research and Training Programs webpage. Please see Appendix 1 for a list of all the NIOSH Funding Opportunity Announcements published in FY2014.

National Occupational Research Agenda (NORA)

The extramural research portfolio is organized into priority areas in occupational safety and health as described in the National Occupational Research Agenda (NORA), a stakeholder-driven research agenda designed to address the most pressing needs in workplace safety and health in the United States. In FY2014, the NIOSH program portfolio was organized around the 10 NORA sector programs and 24 cross-sector programs, which include adverse-health and nonhealth outcomes, statutory programs, and global efforts. Each program area sets priorities for NIOSH work in the sector, monitors NIOSH-funded projects related to its sector, and encourages new NIOSH projects to address sector priorities. More information about these program areas and research priorities may be found on the NIOSH Program Portfolio webpage or by clicking on the program names in Table 1.

Research to Practice (r2p)

NIOSH encourages projects that include Research to Practice (r2p) goals. The r2p program addresses the transfer and translation of research findings, technologies, and information into highly effective prevention practices and products that may be adopted in the workplace. The goal of r2p is to reduce illness and injury by increasing workplace use of effective NIOSH and NIOSH-funded research findings. In order to achieve this, NIOSH works with its partners to focus research on developing effective products, translating research findings into practice, targeting dissemination efforts, and evaluating the effectiveness of these efforts in improving worker safety and health. More information on the NIOSH r2p program can be obtained at the Research to Practice webpage.

NIOSH Program Areas

Table 1. NIOSH Program Areas

NIOSH Sector Program Areas	
Agriculture, Forestry and Fishing	Oil and Gas Extraction
Construction	Public Safety
Healthcare and Social Assistance	Services
Manufacturing	Transportation, Warehousing and Utilities
Mining	Wholesale and Retail Trade
NIOSH Health Outcome Cross-sector Program Areas	
Cancer, Reproductive and Cardiovascular Diseases	Respiratory Diseases
Hearing Loss Prevention	Traumatic Injury
Immune and Dermal Diseases	Work Organizations and Stress Disorders
Musculoskeletal Disorders	
NIOSH Non-health Outcome Cross-sector Program Areas	
Authoritative Recommendations	Occupational Health Disparities
Communications and Information Dissemination	Personal Protective Technology
Economics	Prevention Through Design
Emergency Preparedness and Response	Radiation Dose Reconstruction
Engineering Controls	Small Business Assistance and Outreach
Exposure Assessment	Surveillance
Global Collaborations	Total Worker Health
Health Hazard Evaluation	Training Grants
Nanotechnology	

II. NIOSH EXTRAMURAL RESEARCH ACTIVITY

Funding Distribution FY2014

In FY2014, NIOSH awarded $97,708,126 in extramural funding, a $3.2 million increase over the previous fiscal year. The distribution of awards by type of activity is shown in Figure 1. Fifty-five percent (55%) of the extramural funding went to multidisciplinary centers, followed by 30% for investigator-initiated and career development research grants. Other cooperative research agreements made up 9% of the FY2014 portfolio, followed by individual training project grants (5%) and small business innovation research projects (1%).

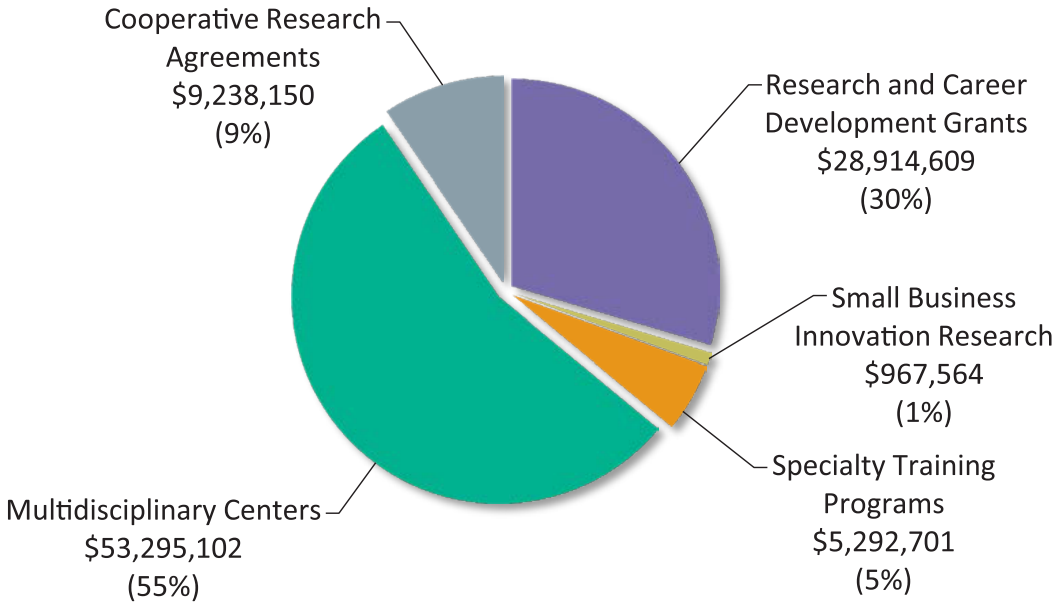


Figure 1. NIOSH extramural grant distribution, FY2014

In FY2014, NIOSH made a total of 188 awards. Of these, 56 (30%) were for new projects and 132 (70%) were continuing awards. A summary of all the NIOSH extramural awards for FY2014 is shown in Table 2. Of the 188 awards made, 33 (18%) were for multidisciplinary research and training centers, which include Education and Research Centers (ERCs), Agriculture Safety and Health (Ag Centers), National Construction, and Centers for a Healthier Workforce; 88 (47%) for investigator-initiated research, career development, 35 (19%) for cooperative research agreements; 30 (16%) for training program grants, and 2 (1%) for small business innovation research. A searchable listing of all active awards funded by NIOSH is available on the OEP webpages.

Summary of All Awards by Type of Funding

Table 2. Summary of all awards by type of funding in FY2014

Award Category	Award Mechanism	Number of Awards	Funding
Multidisciplinary Centers		33	$53,295,102
Education and Research Centers	Training Grant (T42)	18	$26,925,999
Agriculture Safety and Health Centers	Cooperative Research Agreement (U54)	10	$15,832,103
National Construction Center	Cooperative Research Agreement (U60)	1	$5,750,000
Centers for a Healthier Workforce	Cooperative Research Agreement (U19)	4	$4,787,000
Investigator-initiated Research Grants		88	$28,914,609
Research Grants	Investigator-initiated (R01, R03, R21,R13)	81	$28,160,478
Career Developmental Research	Mentored Career Scientist (K01)	7	$754,131
Cooperative Research Agreements		35	$9,238,150
Surveillance	Cooperative Research Agreement (U60)	23	$6,498,530
Agricultural, Forestry and Fishing Safety and Health	Cooperative Research Agreement (U01)	5	$1,374,514
Mesothelioma Tissue Bank	Cooperative Research Agreement (U24)	1	$1,097,000
World Health Organization	Cooperative Research Agreement (E11)	1	$249,988
Hurricane Sandy	Cooperative Research Agreement (U19)	5	$18,118
Specialty Training Programs		30	$5,292,701
Training Project Grants	T01 and T03	27	$4,092,701
Miner Safety and Health Training Program	Cooperative Research Agreement (U60)	3	$1,200,000
Small Business Innovation Research		2	$967,564
Small Business Innovation Research	Phase II (R44)	2	$967,564
Total Extramural Funding		188	$97,708,126

Word cloud of titles of extramural grants funded in FY2014.

Extramural Research Portfolio FY2014

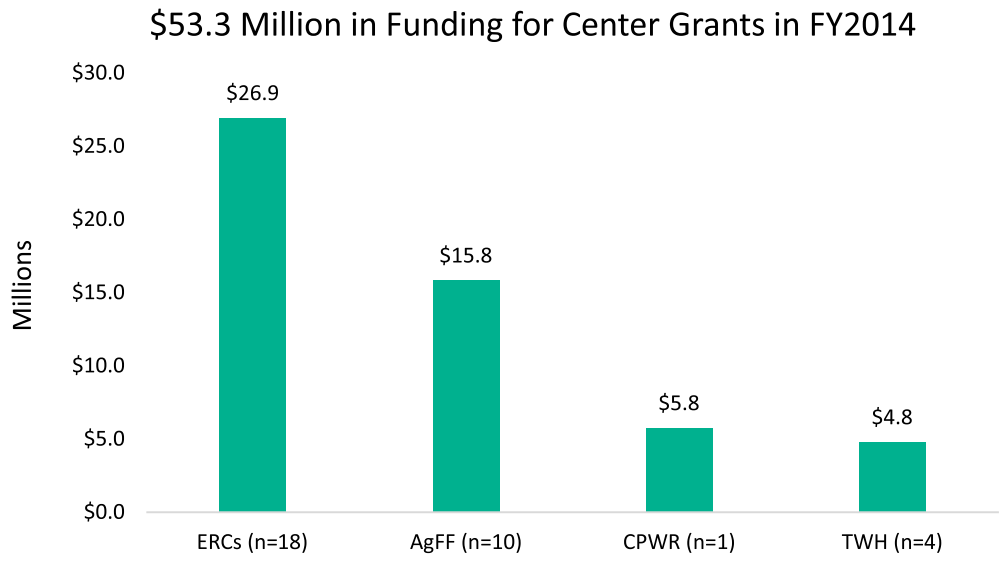
Multidisciplinary Centers

NIOSH funds targeted research and outreach activities through multidisciplinary centers, with a focus on high-risk industries that contribute disproportionately to occupational injury and illness in the United States. These centers are funded through a variety of grant mechanisms, including cooperative research agreements and center training grants. The Agriculture Safety and Health Centers (Ag Centers) and the National Center for Construction Research and Training provide critical research and training into the multiple safety and health hazards in agriculture and construction.

Centers of Excellence to Promote a Healthier Workforce provide a multidisciplinary and multifactorial approach to worker health and wellbeing. The activities of these centers reflect a broader understanding of the critical relationship between work, health, and productivity.

Multidisciplinary education and research activities are carried out through a national network of Education and Research Centers (ERCs). ERCs are university-based centers that provide graduate training in the core and allied fields of occupational safety and health. In addition to degree training, ERCs provide continuing education and outreach to the occupational safety and health community throughout the federal health region they serve.

Approximately $53.3 million was awarded to 33 multidisciplinary centers in FY2014. A total of 18 ERCs received $26.9 million, with $15.8 million awarded to 10 Ag Centers, $5.8 million awarded to the National Construction Center, and $4.8 million (Figure 2) awarded to 4 Centers for a Healthier Workforce. A full description of each of these center portfolios, including a listing of individual center grants, is provided in Appendix 2.



ERCs = Education and Research Centers; AgFF = Agriculture, Forestry, and Fishing; CPWR = National Center for Construction Research and Training; TWH= Centers for a Healthier Workforce.

Figure 2. Multidisciplinary Center Awards, FY2014

Investigator-initiated Research

Research Grants

The goal of the NIOSH extramural research program is to support relevant and high-quality scientific investigations that will help reduce occupational disease and injury. NIOSH responds to that goal by funding investigator-initiated research. These diverse awards include funding for large occupational safety and health research projects (R01), small occupational safety and health research grants (R03), and exploratory occupational safety and health research grants (R21). The extramural research portfolio includes research scientist career development awards (K01), which provide mentored training for the next generation of occupational safety and health scientists. These highly competitive awards provide up to 3 years of funding and a scientific focus designed to develop the skills and productivity of new career scientists. A total of approximately $29 million was awarded to new and continuing research projects and mentored scientist grants in FY2014 (Table 3). A description of investigator-initiated research outputs is provided in Appendix 2.

Conference Grants

NIOSH recognizes the value of supporting high-quality scientific meetings that are relevant to the mission of preventing injury, illness, and deaths caused by hazards in the workplace. Conference grants are awarded under a research grant mechanism (R13), and in FY2014 NIOSH funded one conference grant (see Table 3).

Table 3. Investigator-initiated research funding, FY2014

Type of grant	New Awards	New Funding	Continuing Awards	Continuing Funding	Total Funding
R01	12	$5,363,205	39	$17,700,300	$23,063,505
R21	10	$2,126,603	12	$2,429,301	$4,555,904
K01	4	$431,801	3	$322,330	$754,131
R03	4	$306,529	3	$214,540	$521,069
R13	0	$0	1	$20,000	$20,000
Total	30	$8,228,138	58	$20,686,471	$28,914,609

Cooperative Agreements

Cooperative agreements give NIOSH the ability to arrange collaborative surveillance and research opportunities with state health departments, universities, labor unions, and non-profit organizations. NIOSH provides funding for a broad array of cooperative agreements to develop knowledge for preventing occupational diseases and injury.

Unlike grants, which are conducted independently of the sponsoring agency, cooperative agreements bring together the expertise of federal and nonfederal researchers to accomplish public health efforts that would not otherwise occur. In order for a cooperative agreement to be awarded, there must be a clear need for programmatic staff involvement during performance of a proposed project. An evaluation is made to determine that the cooperative agreement is of sufficient priority to warrant the commitment of staff resources required for a collaborative effort during the term of the cooperative agreement award.

Cooperative research agreements funded in FY2014 totaled $9.2 million and included long-standing state surveillance programs, AgFF funding to support forestry safety research, the Mesothelioma Tissue Bank, support for the World Health Organization's Global Health program, and supplements augmented funding to address Hurricane Sandy. Figure 3 shows the distribution of funding and number of cooperative research agreements.

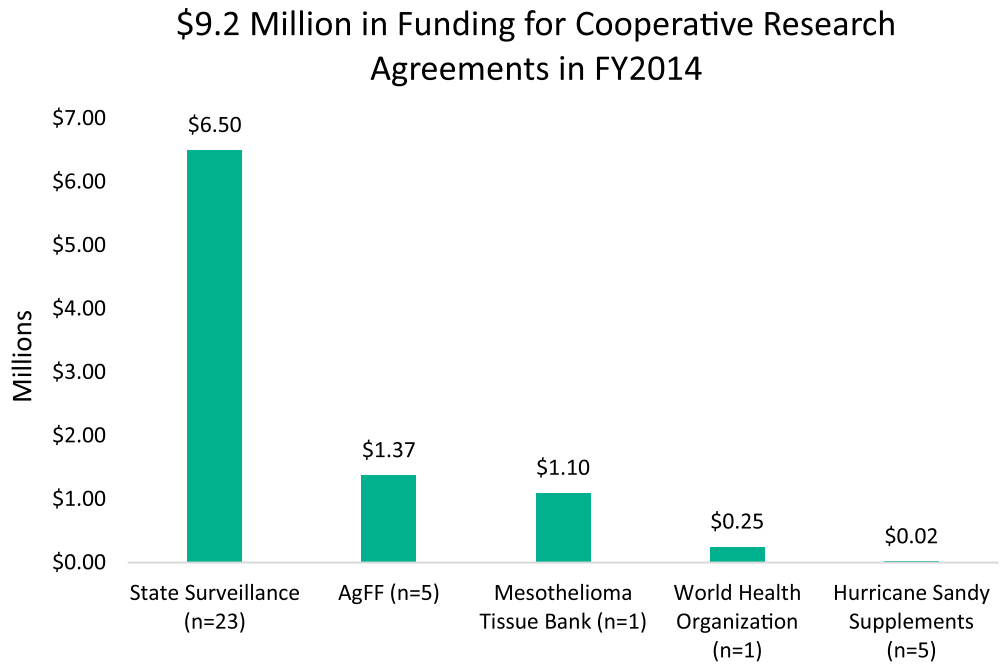


Figure 3. Cooperative Agreements, FY2014

State Surveillance Program

The state surveillance program supports capacity development among states to conduct surveillance of occupational injuries, diseases, deaths, and hazards, and it helps expand the role of states in conducting in-depth surveillance and follow-up through 199 investigations and interventions. These NIOSH-sponsored programs contribute to a national occupational health surveillance strategy for identifying workplace injury and illness and opportunities for research and intervention. Please see the State Surveillance Portfolio Annual Performance Reports for more information on these state-based initiatives. See Table 2 for the number and funding for all state surveillance awards (new and continuing) for FY2014.

Agriculture, Forestry and Fishing

In FY2014, NIOSH's Office of Agriculture Safety and Health began a research cooperative agreement program to accomplish the following:

- Further the understanding of risks and conditions associated with forestry- or logging-related occupational diseases and injuries.
- Explore methods for reducing risks and for preventing or minimizing exposure to hazardous conditions in these work environments.
- Translate significant scientific findings into prevention practices and products that will effectively reduce work-related illnesses and injuries in this area.

In addition, the cooperative agreement program aimed to enhance knowledge about the effectiveness of existing interventions and the best ways to disseminate, diffuse, and translate proven interventions to benefit workers in this work sector—in particular the ability to address the unique needs of vulnerable workers.

Mesothelioma National Tissue Bank

The purpose of the National Mesothelioma Virtual Bank (NMVB) for Translational Research is to maximize the effectiveness of data and biospecimen collection for mesothelioma. This will be a resource on malignant mesothelioma for the biomedical research and the clinical science community. By supporting research studies that address the complex mechanisms and biological changes associated with mesothelioma and its disease progression, the NMVB may ultimately help improve the overall quality of life of current and former workers diagnosed with and treated for malignant mesothelioma.

World Health Organization

NIOSH recognizes the need for global partnerships and participation in accomplishing its mission of providing national and world leadership to prevent work-related illnesses and injuries. Global collaborations can take several forms:

1. Leadership among the World Health Organization's (WHO) global network of occupational health centers.
2. Partnerships to investigate alternative approaches to reduce workplace illness and injury and to provide technical assistance to put solutions in place.
3. International collaborative research.
4. A global professional capacity to address workplace hazards through training, information sharing, and research experience.

NIOSH provides funding to support global occupational safety and health initiatives through long-standing collaboration with the WHO. NIOSH has been active with the WHO Collaborating Center in Occupational Health for the United States since 1976, and it has been involved in program planning, collaborative research, training, management, and direct staff interaction with WHO's Program on Workers' Health.

In addition to giving direct support to the WHO, NIOSH has cosponsored international research training in occupational and environmental health through a very successful collaboration with the NIH's Fogarty International Center. This interagency agreement has supported dozens of research training grants across the globe designed to prepare the next generation of scientists, researchers, and practitioners to deal effectively with the increasing burden of occupational injury and illness around the world. More information about the global health collaboration with NIH and other partners can be found at the Global Environmental and Occupational Health (GEOHealth) webpage.

Hurricane Sandy

Hurricane Sandy was the deadliest and most destructive storm of the 2012 Atlantic hurricane season, as well as the second-costliest in U.S. history. In response, Congress enacted the Disaster Relief Appropriations Act of 2013 (P.L. 113-02), which included public health research funds. In cooperation with overall CDC planning activities, NIOSH identified and supported, through RFA-OH13-002, two priority areas to advance recovery science research from Hurricane Sandy storm-related impacts: (1) conduct training in mold mitigation and health-related research, and (2) conduct assessments of health hazards and outcomes among response and recovery workers and volunteers who performed cleanup and/or reconstruction activities. A competitive grant process in FY13 resulted in five cooperative agreement awards to public and private institutions located in four states—Connecticut, New Jersey, New York, and Virginia.

The Hurricane Sandy research program supports the HHS and CDC overall strategy to contribute to scientific evidence and knowledge and its application to public health preparedness, response, and recovery knowledge and practices. This research also addresses the Disaster Relief Appropriations Act to improve and enhance the emergency preparedness system to protect life and property from disasters and to build organizational capacity, provide training, conduct research, identify data gaps, and improve methods that will prevent and mitigate health hazards and effects among response and recovery workers and volunteers.

Specialty Training Programs

In addition to the Education and Research Centers (ERCs) described under "Multidisciplinary Centers" above, NIOSH supports professional training in occupational safety and health in single disciplines through Training Project Grants. These are individual academic training programs that support undergraduate and graduate training in a single discipline. These programs complement the national network of graduate training provided by ERCs, and they are located throughout the United States.

NIOSH funds a unique Training Project Grant—the Emergency Responder Training Program—through the International Association of Fire Fighters. This grant supports a comprehensive, nationwide hazardous substance training program for fire fighters, paramedics, and other emergency responders across the United States.

The Miner Safety and Health Training Program—Western United States cooperative agreement connects the mining community with mining-relevant information, resources, and methods that increase the capacity and efficacy of safety training for western states' miners. These services and activities are provided by the Western Mining Safety and Health Training Resource Center at the University of Arizona with the Energy, Mining and Construction Industry Safety Program at the Colorado School of Mines. At the end of FY2014, the University of Texas at Arlington Division for Enterprise Development was funded to conduct training in mine safety and join the ongoing efforts in miner's safety training.

The number and funding for all specialty-training grants (new and continuing) awarded in FY2014 are presented in Table 2.

Small Business Innovation Research

The Small Business Innovation Research (SBIR) program stimulates technological innovation in the private sector and strengthens the role of small business in meeting federal research needs or the private sector's own research and development needs by increasing the commercial application of federally supported research results. The NIOSH SBIR program funds early stage small businesses that are seeking to commercialize innovative technologies for occupational safety and health. This competitive program helps small businesses participate in federal research and development, develop life-saving technologies, create jobs, and improve the return on investment from federally funded research for economic and social benefits to the nation. NIOSH issues solicitations for Phase I and Phase II research proposals from science and technology-based firms. Phase II proposals are limited to small businesses that have successfully completed their Phase I projects. Awards and funding for all FY2014 SBIR grants are presented in Table 2.

Extramural Research Activity by NIOSH Program Area

Extramural research activity in FY2014 was distributed across all the NIOSH sector program areas. Figure 4 shows the distribution of funding for investigator-initiated research and career development research across NORA sectors in FY2014. Most FY2014 funding was awarded to projects in the Manufacturing Sector, followed by Healthcare and Social Assistance. No investigator-initiated research funding was attributed to the Wholesale and Retail Trade Sector in FY2014 (Figure 4).

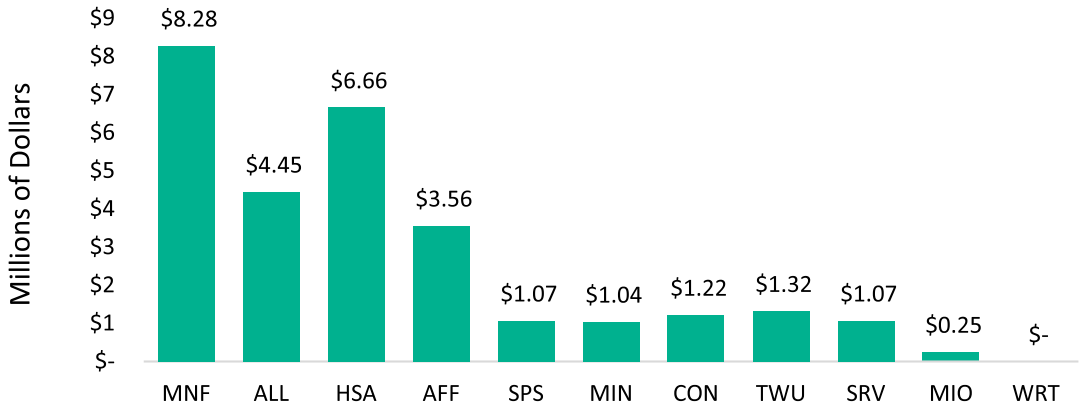


Figure 4. Research funding by sector program, FY2014

Success Rates for Research Project Grants in FY2007–FY2014

The success rate is the percentage of reviewed applications that receive funding on a fiscal year basis, and it is one of the measures of the viability of the research grants program. The success rates for new awards are calculated for the investigator-initiated research only, which includes the R01, R03, and R21 grant mechanisms.

In FY2014, 26 new research awards (R01, R03, and R21 combined) were given out of 154 new applications (Figure 5), for an overall success rate of 17%. The number of new applications in FY2014 increased from 135 in FY2013 to 154 in FY2014. The overall success rate has remained stable over the past several years. The increase in new applications in FY2014 resulted in a decline in the overall success rate to 17%. For the FY2007–FY2014 period, the mean annual number of applications was 173, the mean number of awards was 32, and the mean annual success rate was 19%.

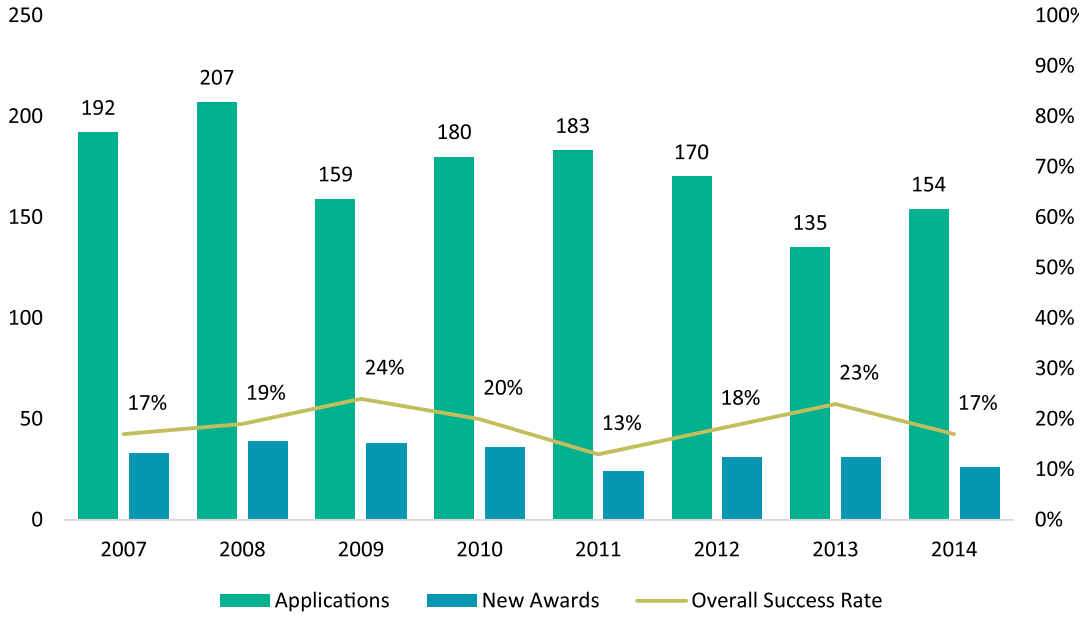


Figure 5. Overall success rates for research project grants (R01, R03, and R21), FY2007–FY2014

R01 Success Rates

Figure 6 shows the success rates for R01 applications from FY2007 to FY2014. Although the success rate over time has remained somewhat stable, with a high of 28% in 2010 and a low of 13% in 2012, the number of applications has declined from 135 in 2007 to 58 in 2014. There has also been a decline in the number of new R01 awards, from a high of 29 new awards in 2008 to a low of 9 awards in 2012. New awards have increased slightly from 2012.

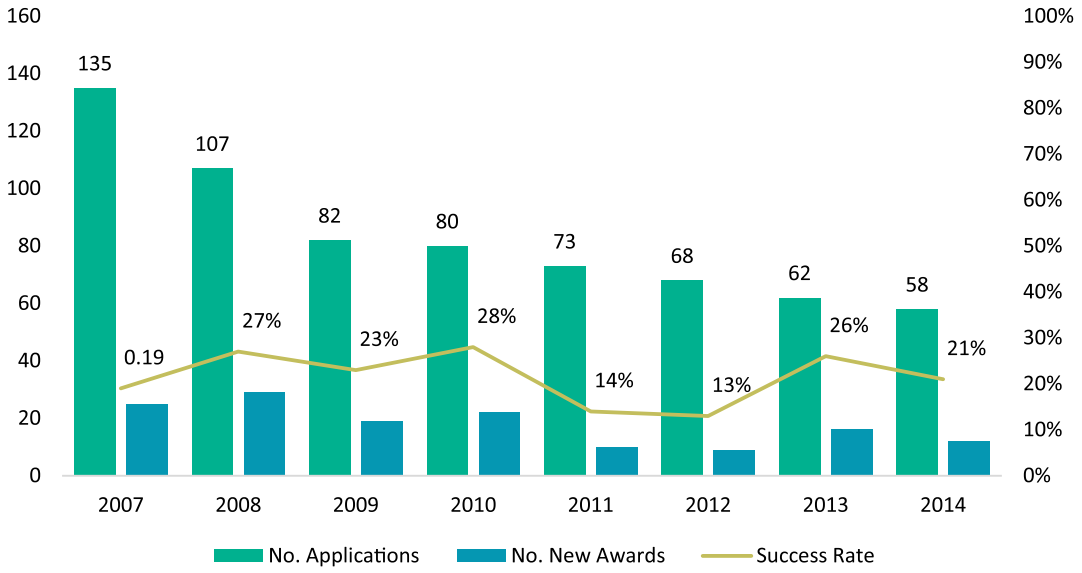


Figure 6. Success rates for R01 applications, FY2007–FY2014

R03 Success Rates

Figure 7 shows the number of R03 applications and new awards made annually from FY2007 to FY2014. Except for a sharp increase in the success rates to 30% in 2009 (most likely due to the decrease in applications that year) overall rates have remained stable from FY2007 through FY2014.

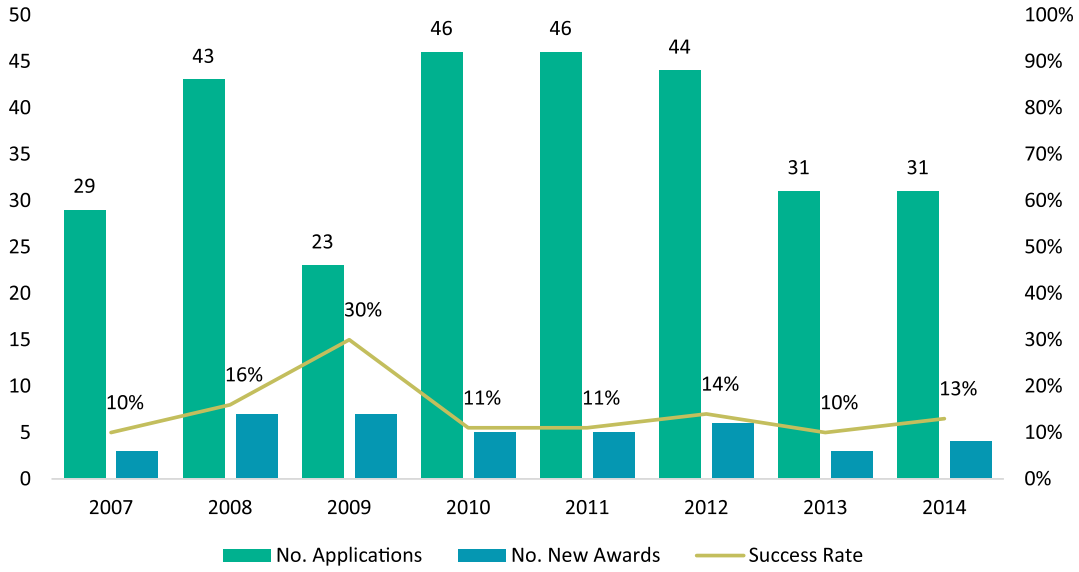


Figure 7. Success rates for R03 applications, FY2007–FY2014

R21 Success Rates

Figure 8 shows the number of R21 applications and new awards made annually from FY2007 to FY2014. The number of R21 applications increased substantially over this time, and the number of new awards has remained somewhat stable since 2009, with a peak of 16 new awards in 2012.

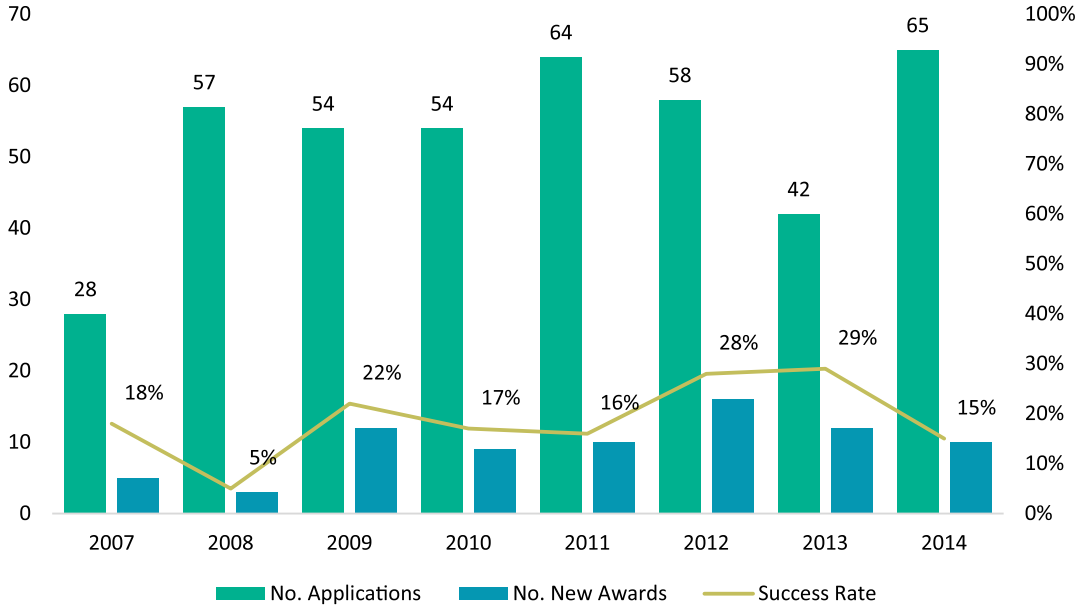


Figure 8. Success rates for R21 applications, FY2007–FY2014

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III. RESEARCH INTEGRATION IN FY2014

Research integration at NIOSH is an effort to strategically align and improve research productivity through coordination, cooperation, and collaboration across intramural and extramural programs. One measure of integrated research programs is the extent to which program goals are addressed by intramural and extramural research. NIOSH conducts an annual assessment of the number of intramural and extramural projects that address common strategic goals of the NORA sector programs. A full listing and description of each sector's strategic plan and agenda can be found on the NORA homepage on the NIOSH website.

Figure 9 shows the strategic goals by number (SG1, SG2, SG3, etc.) for each sector, and it indicates those goals that were addressed by either or both extramural and intramural research projects. In FY2014, all of the strategic goals were addressed in the Agriculture, Forestry and Fishing (AgFF), and Transportation, Warehousing and Utilities (TWU) sectors. Most strategic goals were addressed by both extramural and intramural research in Construction (CON); Healthcare and Social Assistance (HSA); Manufacturing (MNF); Mining (MIN); Public Safety (SPS); and Wholesale and Retail Trade (WRT). In the Oil and Gas Extraction (MIO) and Services (SRV) sectors, most of the strategic goals were addressed by intramural research projects.

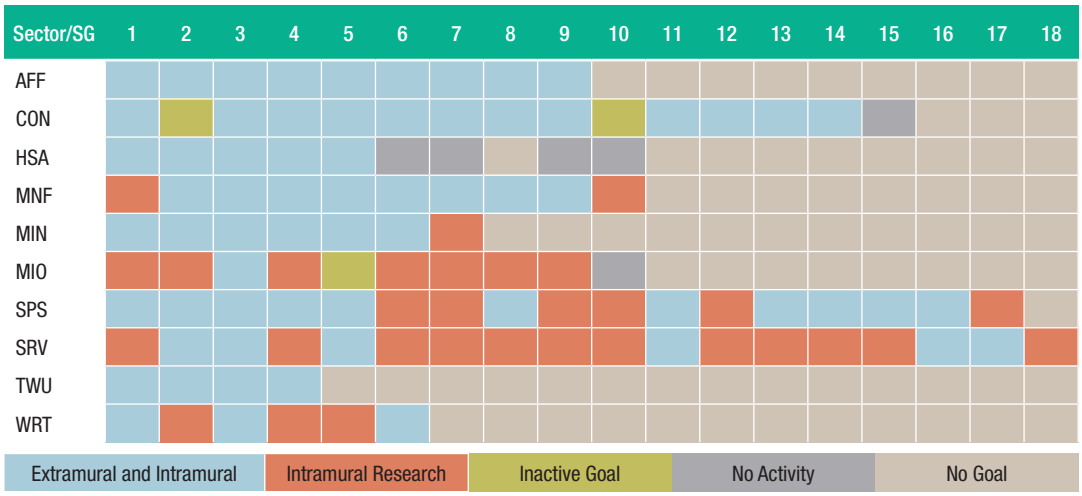


Figure 9. Integration of NIOSH Research Goals by Sector, FY2014

Integrated Research Activity by Sector Strategic Goals, FY2014

In order to better characterize NIOSH-funded research in FY2014, a review was conducted of the strategic goals addressed by extramural and intramural projects by industry sectors. The following tables identify the sector program strategic goals that were addressed by extramural and intramural research projects. A description of each sector's strategic goals can be found on the NORA webpage.

Agriculture, Forestry and Fishing

Table 4 displays the strategic goals addressed by extramural and intramural research projects in the Agriculture, Forestry and Fishing Sector in FY2014. All strategic goal areas were supported by both intramural and extramural research projects. The strategic goal most frequently addressed by extramural and intramural projects was SG1: Surveillance, followed by SG5: Agricultural Health and SG 2: Vulnerable Workers.

Table 4. Agriculture, Forestry and Fishing research projects by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Surveillance	37	27
SG2: Vulnerable Workers	17	18
SG3: Outreach and Partnerships	15	12
SG4: Agricultural Safety	11	7
SG5: Agricultural Health	23	24
SG6: Forestry Injuries	2	5
SG7: Forestry Illness/Disease	2	8
SG8: Commercial Fishing Injuries	2	5
SG9: Commercial Fishing Illness/Disease	2	9

Construction

Table 5 displays the strategic goals addressed by extramural and intramural research projects in the Construction Sector in FY2014. All strategic goal areas were supported by both intramural and extramural research projects, except SG2, which was only supported by intramural research projects. The strategic goal most frequently addressed by extramural projects was SG14: Surveillance; the goals most frequently addressed by intramural projects were SG5: Silica and SG14: Surveillance.

Table 5. Construction research projects by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Falls Prevention	4	12
SG2: Electrocution	0	1
SG3: Struck-by Incidents Prevention	4	9
SG4: Hearing Loss Prevention	3	8
SG5: Silica	4	30
SG6: Welding Fumes	6	22
SG7: Musculoskeletal Disorders	14	10
SG8: Safety and Health Cultures	4	7
SG9: Safety and Health Management	3	9
SG10: Industry and Work Organization	3	4
SG11: Training and Education	3	9
SG12: Health Disparities	5	18
SG13: Prevention through Design	5	13
SG 14: Surveillance	33	30

Healthcare and Social Assistance

Table 6 displays the strategic goals addressed by extramural and intramural research projects in the Healthcare and Social Assistance Sector in FY2014. All strategic goal areas were supported by both extramural and intramural research projects, except SG8, which was only supported by intramural research projects. The strategic goal most frequently addressed by extramural projects was SG1: Safety Culture; for intramural projects SG5: Infectious Disease was most frequently addressed.

Table 6. Healthcare and Social Assistance research projects by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Safety Culture	12	29
SG2: Musculoskeletal Disorders	9	6
SG3: Hazardous Drugs and Chemicals	4	29
SG4: Sharp Injuries	2	6
SG5: Infectious Disease	5	32
SG8: Respiratory Hazards In Veterinary Medicine and Animal Care	0	2

Manufacturing

Table 7 displays the strategic goals addressed by extramural and intramural research projects in the Manufacturing Sector in FY2014. All strategic goal areas were supported by both extramural and intramural research projects, except SG1 and SG10, which were only supported by intramural research projects. The strategic goal most frequently addressed by extramural and intramural projects was SG5: Respiratory Disease. The strategic goal least frequently addressed was SG8: Small Business among extramural projects, while among intramural projects, the least frequently addressed strategic goals were SG10: Catastrophic Incidents and SG2: Falls among intramural projects.

Table 7. Manufacturing research by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Contact with Objects and Equipment	0	17
SG2: Falls	2	3
SG3: Musculoskeletal Disorders	12	20
SG4: Hearing Loss	5	16
SG5: Respiratory Disease	19	92
SG6: Cancer	10	34
SG7: Vulnerable Populations	3	18
SG8: Small Business	1	22
SG9: Emerging Risks	9	81
SG10: Catastrophic Incidents	0	3

Mining

Table 8 displays the strategic goals addressed by extramural and intramural research projects in the Mining Sector in FY2014. All strategic goal areas were supported by both extramural and intramural research projects, except SG7, which was only supported by intramural research projects. The strategic goal most frequently addressed by both extramural and intramural projects was SG1: Respiratory Diseases.

Table 8. Mining research by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Respiratory Diseases	8	52
SG2: Noise-Induced Hearing Loss	4	16
SG3: Musculoskeletal Disorders	5	15
SG4: Traumatic Injuries	5	26
SG5: Disaster Response and Prevention	7	31
SG6: Ground Failure Fatalities and Injuries	2	14
SG7: Interventions with New Technologies	0	11

Oil and Gas Extraction

Table 9 displays the strategic goals addressed by extramural and intramural research projects in the Oil and Gas Extraction Sector in FY2014. All but SG1: Transportation-Related Injuries and Fatalities were addressed by intramural research, and only one extramural project addressed a Strategic Goal (SG3: Falls). The strategic goal most frequently addressed by intramural projects was SG6: Chemical Exposures.

Table 9. Oil and Gas Extraction research by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Transportation-Related Injuries and Fatalities	0	8
SG2: Contact Injuries	0	4
SG3: Falls	1	5
SG4: Fires and Explosions	0	3
SG6: Chemical Exposures	0	21
SG7: Industry-Specific Interventions	0	7
SG8: Fatigue	0	1
SG9: Vulnerable Workers	0	3

Public Safety

Table 10 displays the strategic goals addressed by extramural and intramural research projects in the Public Safety Sector in FY2014. A majority of strategic goal areas were supported by intramural research, with SG1: Chronic Disease in Fire Fighters, the most frequently addressed. Extramural projects most frequently addressed SG4: Musculoskeletal Disorders and SG15: Work Organization in EMS.

Table 10. Public Safety research by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Chronic Disease in Fire Fighters	1	43
SG2: Structural Firefighting Operations	1	15
SG3: Vehicle-Related Injuries in Fire Fighters	1	8
SG4: Musculoskeletal Disorders	4	2
SG5: Surveillance in Law Enforcement	1	10
SG6: Vehicle-Related Injuries in Law Enforcement	0	11
SG7: Criminal Assaults in Law Enforcement	0	1
SG8: Cardiovascular Disease in Law Enforcement	1	6
SG9: Traumatic Injury in Corrections	0	2
SG10: Infectious Disease in Corrections	0	6
SG11: Occupational Stress in Corrections	1	3
SG12: Vehicle-Related Injuries in EMS	0	5
SG13: Patient- and Equipment-Handling Injuries in EMS	1	3
SG14: Infectious Disease and Hazardous Exposures in EMS	1	19
SG15: Work Organization in EMS	3	3
SG16: Surveillance in EMS	1	7
SG17: Wildland Fire Fighting	0	2

Services

Table 11 displays the strategic goals addressed by extramural and intramural research projects in the Services Sector in FY2014. Most of the strategic goals were addressed by intramural research projects; SG17: Surveillance was the goal most frequently addressed by both extramural and intramural research.

Table 11. Services research strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Illnesses and Fatal Injuries in Auto Repair	0	7
SG2: Illnesses and Injuries in Building Services	1	15
SG3: Health Disparities in Building Services	1	3
SG4: Illnesses and Injuries in Schools	0	22
SG5: Injuries in Hotel/Motel Industry	1	6
SG6: Illnesses in Hotel/Motel Industry	0	13
SG7: Health Disparities in Hotel/Motel Industry	0	3
SG8: Injuries/Illnesses in Government	0	15
SG9: Traumatic Injuries in Recreation and Entertainment Industries	0	1
SG10: Injuries in Food Services	0	5
SG11: Violence in Food Services	1	2
SG12: Injuries/Illnesses in Telecommunications	0	6
SG13: Traumatic Injuries in Telecommunications	0	2
SG14: Temporary Labor/Contractors/ Contingent Workers	0	1
SG15: Injuries in Waste Collection, Disposal and Recycling Industries	0	3
SG16: Musculoskeletal Disorders	6	8
SG17: Surveillance	31	37
SG18: Injuries/Illnesses in Nail and Hair Salons	1	1

Transportation, Warehousing and Utilities

Table 12 displays the strategic goals addressed by extramural and intramural research projects in the Transportation, Warehousing, and Utilities Sector in FY2014. All strategic goal areas were supported by both extramural and intramural research projects. The strategic goals most frequently addressed by extramural projects were SG2: Musculoskeletal Disorders, followed by SG4: Chemical/Biological/Physical Hazards and SG1: Traumatic Injuries. The goals most frequently addressed by intramural projects were SG4: Chemical/Biological/Physical Hazards, followed by SG1: Traumatic Injuries and SG2: Musculoskeletal Disorders.

Table 12. Transportation, Warehousing and Utilities research by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Traumatic Injuries	5	26
SG2: Musculoskeletal Disorders	6	15
SG3: Health and Wellness Programs	1	9
SG4: Chemical/Biological/Physical Hazards	5	41

Wholesale and Retail Trade

Table 13 displays the strategic goals addressed by extramural and intramural research projects in the Wholesale and Retail Trade Sector in FY2014. Most of the strategic goal areas were supported by intramural research projects with extramural research most frequently addressing SG1: Musculoskeletal Disorders, followed by SG3: Violence. Goals most frequently addressed by intramural research were SG6: Vulnerable Workers, followed by SG1: Musculoskeletal Disorders.

Table 13. Wholesale and Retail Trade research by strategic goal, FY2014

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Musculoskeletal Disorders	7	16
SG2: Traumatic Injuries	0	8
SG3: Violence	4	5
SG4: Vehicle-Related Injuries	0	7
SG5: Small Business Outreach	0	7
SG6: Vulnerable Workers	2	21

IV. FY2014 EXTRAMURAL RESEARCH OUTPUTS

Outputs are the products of research activities. Examples include publications, reports, conference proceedings, presentations/posters, databases, tools, methods, guidelines, recommendations, education and training materials, inventions, and patents. This section describes the outputs of NIOSH-funded extramural research during FY2014.

Summary of Peer-reviewed Publications for FY2014

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, NIOSHTIC-2 database, and PubMed database. From October 1, 2013, to September 30, 2014, there were 532 publications across 237 different journals. Table 14 shows the number of publications by funding activity. This represents a 63% increase in the number of publications reported for FY2013 (334 publications in 152 journals). Researchers published their NIOSH-funded research in an array of journals related to occupational safety and health. The journal most frequently published in was the *American Journal of Industrial Medicine* (n=32), followed by the *Journal of Occupational and Environmental Hygiene* (n=31), *Occupational and Environmental Medicine* (n=20), and *Human Factors* (n=18). A searchable database of NIOSH publications can be found at Grantee Award Final Reports and Publications on the OEP webpages.

Table 14. Number of publications by funding type, FY2014

Funding Type	Number of Publications
Research Project Grants (R01)	133
Education and Research Center Grant (T42)	215
Agricultural Safety and Health Center (U50, U54)	72
Small Research Grant (R03)	7
National Center for Construction Research and Training, State Surveillance Program, and Construction Cooperative Agreement (U60)	29
Exploratory Development Grant (R21)	22
Total Worker Health Center (U19)	35
Mentored Research Scientist Development Award (K01)	6
Conference (R13)	1
Research Demonstration and Dissemination Grant (R18)	1
Education Projects (R25)	2
Training Project Grant (T01 and T03)	32
Dissertation Award (R36)	1
Total*	556*

*Total number is greater than 532 publications because a publication could acknowledge more than one source of funding.

Impact Factor

The impact factor is frequently used as a proxy for the relative importance of a journal within its field, with journals with higher impact factors deemed more important than those with lower ones. Although the impact factor is useful to compare different journals within a certain field, comparison across different fields using the impact factor is considerably less useful.

The journals in which the NIOSH-funded extramural researchers publish their research findings span multiple fields, disciplines, and subject areas, thus making it difficult to compare the impact factors across these different fields. Top-ranked research journals in FY2014 included the second-ranked journal in the field of medicine (*The Journal of the American Medical Association*, impact factor = 35.289) and the second-ranked journal in the field of public, environmental, and occupational health (*Nature Chemistry*, impact factor = 25.325). Impact factors for all publications in FY2014 ranged from a minimum of 0.233 to a maximum of 35.289.

V. APPENDICES

APPENDIX 1: NIOSH Funding Opportunity Announcements by Mechanism, FY2014

Funding Opportunity	Mechanism	Title
		Investigator-initiated Research
PAR-13-245	K01	Mentored Research Scientist Development Award
PAR-13-129	R01	Occupational Safety and Health Research
PAR-12-200	R03	NIOSH Small Research Program
PAR-OH-14-246	R13	NIOSH Support for Conferences and Scientific Meetings
PAR-12-252	R21	NIOSH Exploratory/Developmental Grant Program
		Training Programs and Centers
PAR-10-288	T03	Occupational Safety and Health Training Project Grants
PAR-10-217	T42	Occupational Safety and Health Education and Research Centers
		Cooperative Agreements
PAR-14-175	U01	Agricultural, Forestry and Fishing Safety and Health Research
PAR-14-229	U13	NIOSH Support for Conferences and Scientific Meetings
RFA-OH-11-001	U19	Centers of Excellence to Promote a Healthier Workforce
RFA-OH-14-010	U24	National Mesothelioma Virtual Bank for Translational Research
RFA-14-005	U54	National Center of Excellence for the Prevention of Childhood Agricultural Injury
PAR-14-227	U60	Workers Compensation Surveillance
PAR-14-275	U60	State Occupational Health and Safety Surveillance Program
RFA-OH-13-001	U60	National Center for Construction Safety and Health Research and Translation
RFA-OH-14-004	U60	Miner Safety and Health Training Program—Western United States
RFA-OH-14-002	E11	Cooperative Agreement on Occupational Health with the World Health Organization: Implementing 'Global Plan of Action for Workers' Health 2008–2017'
		Co-Sponsored Research with the National Institutes of Health
PA-14-071	R43, R44	PHS 2014-02 Omnibus Solicitation of the NIH, CDC, FDA and ACF for Small Business Innovation Research Grant Applications
RFA-TW-14-002	U2R	Hubs of Interdisciplinary Research and Training in Global Environmental and Occupational Health (GEOHealth)—Research Training
RFA-TW-14-001	U01	Hubs of Interdisciplinary Research and Training in Global Environmental and Occupational Health (GEOHealth)—Research

APPENDIX 2: FY2014 Extramural Portfolio Highlights

A. Multidisciplinary Centers

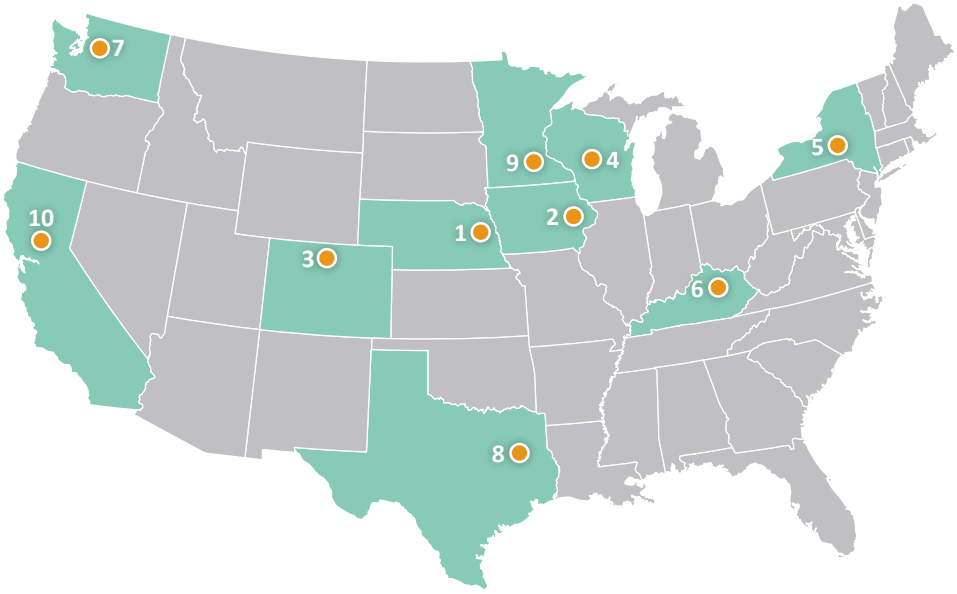
NIOSH funds targeted research and outreach activities through multidisciplinary centers, with a focus on high-risk industries that contribute disproportionately to occupational injury and illness in the United States. These centers are funded through a variety of grant mechanisms, including cooperative research agreements and center training grants.

1. Agricultural Safety and Health Centers

a. Overview

The Centers for Agricultural Disease and Injury Research, Education, and Prevention represent a major NIOSH effort to protect the safety and health of agricultural workers and their families. In 1990, the NIOSH ag centers were established as a part of the NIOSH Agricultural Safety and Health Initiative. The centers were established by cooperative agreement to conduct research, education, and prevention projects to address the nation's pressing agricultural safety and health problems. Geographically, the centers are distributed throughout the nation to be responsive to the agricultural safety and health issues unique to the different regions.

NIOSH Centers for Agricultural Disease and Injury Research, Education, and Prevention



1. University of Nebraska Medical Center, Omaha
2. University of Iowa, Iowa City
3. Colorado State University, Ft. Collins
4. National Farm Medicine Center, Marshfield, WI
5. Bassett Healthcare, Cooperstown, NY
6. University of Kentucky, Lexington
7. University of Washington, Seattle
8. University of Texas Health Science Center, Tyler
9. University of Minnesota, Minneapolis
10. University of California, Davis

b. Public Health Relevance

In 1990, Congress established a national initiative in agriculture safety and health under Public Law 101-517. It was anticipated that this initiative, "… when sustained over a period of time, would result in a significant and measureable impact on … health effects among rural Americans." In response, NIOSH began funding the Centers for Agricultural Disease and Injury Research, Education, and Prevention in 1991. The aim was to improve worker safety and health in the agriculture, forestry, and fishing industries—occupations that consistently ranked among the most dangerous in the United States. Currently, NIOSH funds nine regional centers and a national center that focuses exclusively on childhood agricultural risks. Although it is still true today that these occupations rank as some of the most dangerous, there have been significant decreases in overall morbidity and mortality in this work sector since the initiative's inception almost 25 years ago. These improvements are at least partially attributable to the work done by the centers during this time.

The centers' work spans the full research-to-practice continuum. They conduct basic science to evaluate and quantify a problem, as well as translating these results into engineering controls, educational outreach efforts, or policy changes aimed at preventing or mitigating the problem. Although the centers' research is fundamental to the creation and validation of evidence-based approaches, the real impacts occur when these approaches are actively implemented through practical education, outreach, and prevention projects within their respective regions. Geographic diversity in agriculture, forestry, and fishing activities drives the need for regional engagement by the centers.

The contributions of the centers to public health include the following:

- Integrating expertise from multiple disciplines, institutions, and community partners to solve complex problems.
- Providing a continuum of basic research through translation and outreach activities that turn findings into evidence-based prevention programs.
- Addressing the many cultural, ethnic, educational, and language obstacles that are significant barriers to safety and health for many laborers in this workforce.
- Contributing expertise to agricultural industries in the fields of medicine, nursing, industrial hygiene, epidemiology, engineering, and education.

c. Program Highlights in FY2014

Regional Centers Help Prevent Lung Disease among Agricultural Workers

Farm work may invoke images of clean outdoor air, but—in reality—it can expose workers to hazardous substances that increase the risk of lung disease. To protect workers, the NIOSH Centers for Agricultural Disease and Injury Research, Education, and Prevention instruct about eliminating exposures or using engineering controls and personal protective equipment to reduce risk. In addition, the centers conduct basic research to define new hazards and epidemiologic studies to examine potential links between these hazards and worker illness and death. Although the centers' work often has far-reaching implications, their regional focus benefits local workers first, as the examples below show:

California

Activities focus on preventing valley fever, or Coccidioidomycosis, among Hispanic workers, who are at increased risk of exposure. Endemic to parts of the southwest, this fungal disease is of particular concern in the dry and dusty San Joaquin Valley. At the California Center, prevention begins with identifying high-risk crops and tasks.

Colorado

Activities focus on preventing lung diseases related to the dairy industry, which is a large employer in this part of the country. These diseases, including chronic bronchitis and occupational asthma, are a significant problem among dairy workers and contribute to high employee turnover, decreased productivity, and higher worker compensation costs.

Minnesota and Iowa

Activities address pork production and confined-feeding operations, which can expose workers to airborne contaminants such as hydrogen sulfide, ammonia, endotoxin, and particulate matter. Seasonal influences on exposures are an important focus because the harsh Midwestern winters keep animals confined indoors, greatly increasing the concentrations of these air contaminants and the risk to workers. To improve air quality, research aims to identify how to remove these contaminants through ventilation.

Nebraska

Studies of organic dust exposure clarify the biological processes that lead to allergic and non-allergic asthma in farm workers. The Nebraska Center also examines the abilities of rural health care providers to correctly evaluate, diagnose, and treat agricultural lung diseases.

Texas

Activities focus on basic research of the biological mechanisms underlying lung disease among poultry workers. Because the poultry industry is primarily located in the south, the Texas Center also funds outreach activities in multiple southern states to increase respirator use among broiler-chicken workers and to identify barriers to using this equipment.

2. National Center for Construction Research and Training

a. Overview

The CPWR, the Center for Construction Research and Training (CCRT), was awarded NIOSH's National Construction Center cooperative agreement for 2009–2014 through an extramural competition. NIOSH intends for this partner, with its diverse construction community, to serve as a leader in applied construction research and to diffuse and disseminate effective interventions to the construction industry. The CCRT, along with its consortium of 10 academic partners, conducts research to identify causes of, and solutions for, safety and health risks that construction workers face on the job. Most of the research projects support NORA construction research goals as well as emerging issues.

b. Public Health Relevance

For the past 25 years, the CPWR—Center for Construction Research and Training has been funded, through a series of competitive program announcements, as the NIOSH-sponsored Center of Excellence for Construction Safety and Health Research. For FY2014, CPWR's research activities addressed NORA Construction Goals 1 through 15, spanning applied research for hazards and health conditions, research to practice for various construction trades, emerging issues research in nanomaterials, construction industry data and tracking, and dissemination and transfer of research. Research projects also respond to the National Academy of Sciences' recommendations for the NIOSH construction research program, including dissemination and diffusion of research-to-practice solutions. CPWR has cultivated and optimized external partnerships for prevention, protections, research, and research translation for the protection of construction workers in the United States.

c. Program Highlights in FY2014

Technology Transfer and Interventions for Construction Workers: For many safety and health researchers, the steps in transferring a completed research (the technology) from the laboratory to the jobsite (the marketplace) are new territory. Even for those who have experience with technology transfer, it can be a complicated process. Professionals at CPWR developed, published, and disseminated three noteworthy technology transfer guidance documents. To overcome the challenges of technology transfer, several examples and case study (e.g., examining the inventor-manufacturer relationship) of university technology transfer policies and resources are highlighted to help construction safety researchers and inventors move their technology to the marketplace. Each of the guidance documents examined the nature of technology transfer for construction from a unique professional or organization perspective. A high-interest guidance is "Resources for Technology Transfer in Construction: A Roadmap for Construction Safety and Health Researchers—from the Laboratory to the Jobsite." More multi-perspective information in three key publications can be found on the CPWR Publications website.

Research to Practice Initiatives at CPWR: Research to practice (r2p) emphasizes a systematic approach to promote the broad-based application of research-based solutions to improve health and safety practices in the construction industry. A variety of dissemination strategies can be used in r2p efforts, importantly including the input and support of construction stakeholders. CPWR professionals crafted case studies in r2p dissemination strategies, utilized by researchers and other stakeholders, to advance the use of research-based solutions and reduce the risk for occupational injuries and illnesses on construction sites. These case studies address target audiences and topics, including construction policy and standards, professional organizations' policies, safety culture and climate in construction, model specifications bid language, voluntary consensus standards and certification programs, and model safety language for contracts. These and other training and communications (e.g., social marketing in construction safety) related r2p resources are available on the CPWR r2p website.

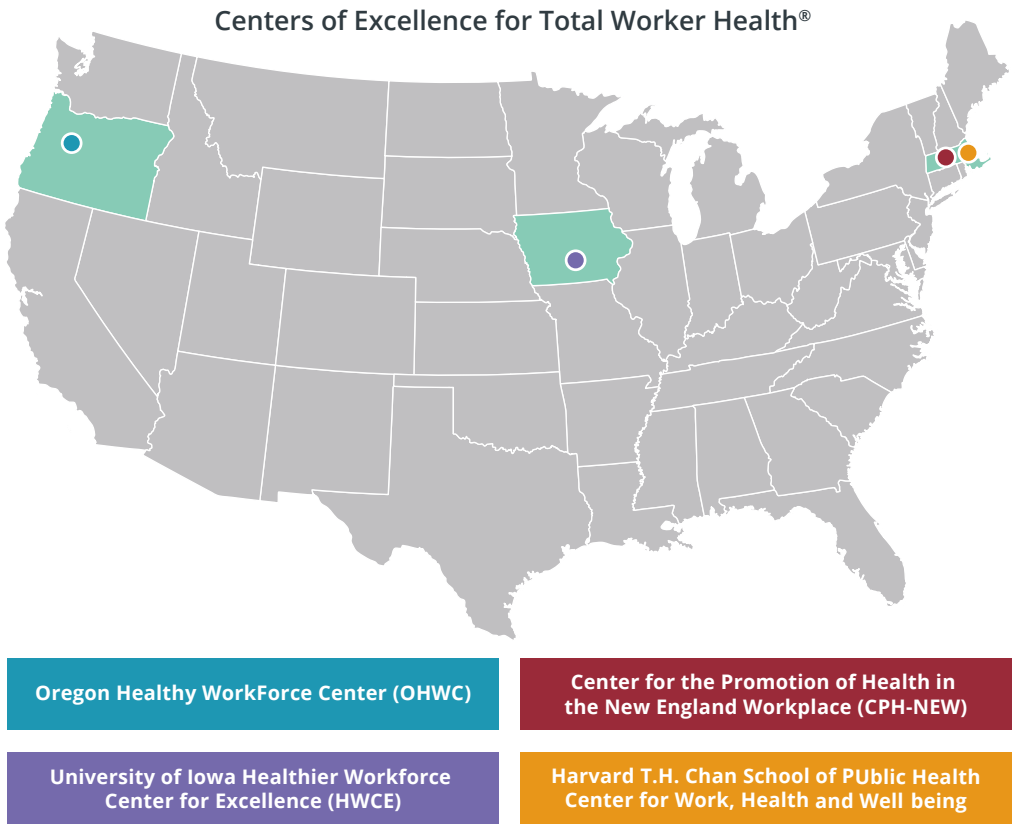
3. Centers of Excellence to Promote a Healthier Workforce

a. Overview

NIOSH has funded Centers of Excellence to explore and research the concepts of Total Worker Health™ (TWH). The centers' research examines the integration and cross-promotion of worker protection, worksite enhancement, and interventions for worker health promotion. The effort strives to recognize the synergy in combining efforts to reduce personal health risk factors with traditional safety and psychosocial stress hazard reduction approaches in the workplace.

Efforts include the following:

- Pilot testing of promising workplace policies and programs.
- Developing and disseminating best practices and tool kits.
- Developing strategies for overcoming barriers to organizational acceptance and adopting comprehensive, coordinated work-based health protection and promotion interventions.
- Investigating costs and benefits associated with integrated programs.
- Promoting increased development and application of physiological and biological markers of stress, sleep, and depression and their use for worker protection or improved health outcomes.



b. Public health relevance

The Centers of Excellence develop and evaluate interventions that have improved safety, health, wellness and well-being—TWH—in high-risk industries that can reduce healthcare costs when adopted on a broad scale. The centers facilitate translation from research to practice, testing the process and feasibility of implementing TWH approaches in real-world environments spanning the multiple sectors of manufacturing, healthcare, and construction. Efforts include an integrative and comprehensive approach to reduce workplace hazards and promote worker health, through its identification of the links between workplace culture and personal high-risk behaviors, as well as issues that transcend the workplace, such as work-family strain.

c. Selected Program Highlights FY2014

Integrated Approaches to Improving the Health and Safety of Healthcare Workers

The Harvard Center for Work, Health, and Well-being developed the "Be Well, Work Well" intervention to reduce musculoskeletal disorders, or MSDs. The intervention also sought to improve health-related behaviors, such as physical activity, sleep, and dietary patterns among healthcare workers. The researchers tested the feasibility of changing policies and practices in participating patient-care units in a small-scale proof-of-concept study to help foster healthy and safe behaviors through programs for workers on these units. Researchers designed this intervention in response to some of the unique challenges faced by these workers. Examples included the need to provide round-the-clock care (including on weekends and holidays), psychological distress associated with patient care, and physical demands that often require long periods of standing. Lessons learned from this study will inform future research within healthcare settings. Healthcare settings are receiving increased attention because of the high risks of injury workers face and the many barriers to risk reduction.

Health Worksite Physical Activity Intervention for Ambulatory Clinic Registered Nursing Staff—Nursing is one of the most hazardous occupations. Nurses often work long and irregular hours that limit their opportunities for engaging in healthy behaviors, such as physical activity. Physical activity is not only good for the health of the employee, but it can reduce safety risks and the number of sick days, and it can improve work productivity. The Healthier Workforce Center for Excellence at the University of Iowa tested the effectiveness of a workplace intervention with hospital nurses to increase low-intensity physical activity on the job. The center used workstation treadmills, walking meetings, stair climbing, gaming, and 3-minute video clips. The center also sent text messages reinforcing these concepts to employees. The intervention increased physical activity in the workday by 22 minutes and decreased absenteeism without reducing self-reported work productivity. This method is critical to other workplaces that adopt these programs.

Creating Health and Safety "Communities of Practice" for Homecare Workers—The Oregon Healthy Workforce Center (OHWC) is using a peer-led scripted curriculum to organize homecare workers into neighborhood-based teams that provide education and social support for improving lifestyle (e.g., diet, exercise) and safety behaviors.

In partnership with the Service Employment International Union Local 503 and the Oregon Home Care Commission, the center developed and pilot-tested the Community of Practice and Safety Support, known as COMPASS. The center recruited 148 homecare workers in 2013–14. They placed the workers in randomly assigned clusters.

- The sample is predominantly female, Caucasian, and averaged just over 50 years of age with a body mass index over 30.
- Attendance averaged more than 80%.
- Mean favorability rating was more than 4 on a 5-point scale.
- Average knowledge gain (pre/post meeting) was close to 20% (due to high pre-test knowledge of lifestyle information).
- Half of participants reported making behavior changes due to the program.

Integrated Approaches to Health and Safety in dynamic Construction Work Environment

"All the Right Moves," emphasizes Total Worker Health. All the Right Moves integrates health protection and promotion into one intervention program. Harvard T.H. Chan School of Public Health Center for Work, Health, and Well-being implemented the All the Right Moves program in two phases—Soft Tissue Injury Prevention Planning (SIPP) and Health Week. For the SIPP component, safety managers add ergonomics observations to their weekly safety inspections and upload them using the developed online inspection tool. The center then generates weekly reports and can target multiple levels of organization by communicating these observations to both supervisors and workers during weekly supervisors meetings and through on-site posters. Following the SIPP program, information and resources were presented during a 5-day Health Week, addressing ergonomics, diet and physical activity, and tobacco cessation. Throughout the week, workers are offered the opportunity to enroll in free over-the-phone health coaching and could sign up to receive a free 8-week supply of nicotine replacement therapy.

Supervisor training to promote health/safety in construction (Latino and non-Latino)—Oregon Health Workforce Center is enhancing supervisor team building training skills, supported by behavior-tracking technology, to motivate its employees to adopt healthier lifestyle choices and safer work practices, in Latino and non-Latino supervisors in the construction industry. Funded in 2012, the center developed the training and a structured 12-week approach to wellness for employees. Reactions to the wellness training were positive among nine International Union of Painters and Allied Trades apprentices (IUPAT) and improvements in several wellness measures and team cohesion were seen in the apprentices.

Partnership and Its Impact

A recent impact of the CPH-NEW/Massachusetts Department of Public Health MDPH partnership is the inclusion of minimal occupational safety and health requirements in a state tax credit for small businesses with WHP programs; and inclusion of health protection

"integration" in the 2015 Wellness program developed by the Massachusetts Prevention and Wellness Trust.

Through the CPH-NEW/Connecticut Department of Corrections (DOC) partnership, a participatory team that included line officers, supervisors, and the deputy warden, developed its own slogans, such as "Eating for Action," which was intentionally not limited to a weight-loss focus. The team and the investigators designed instructional posters on the causes of and solutions to adverse eating patterns and developed healthy choice menus for popular local eateries that provide take-out food. This is currently being adopted throughout Connecticut DOC.

Efforts to Evaluate the Effectiveness of the TWH Approach

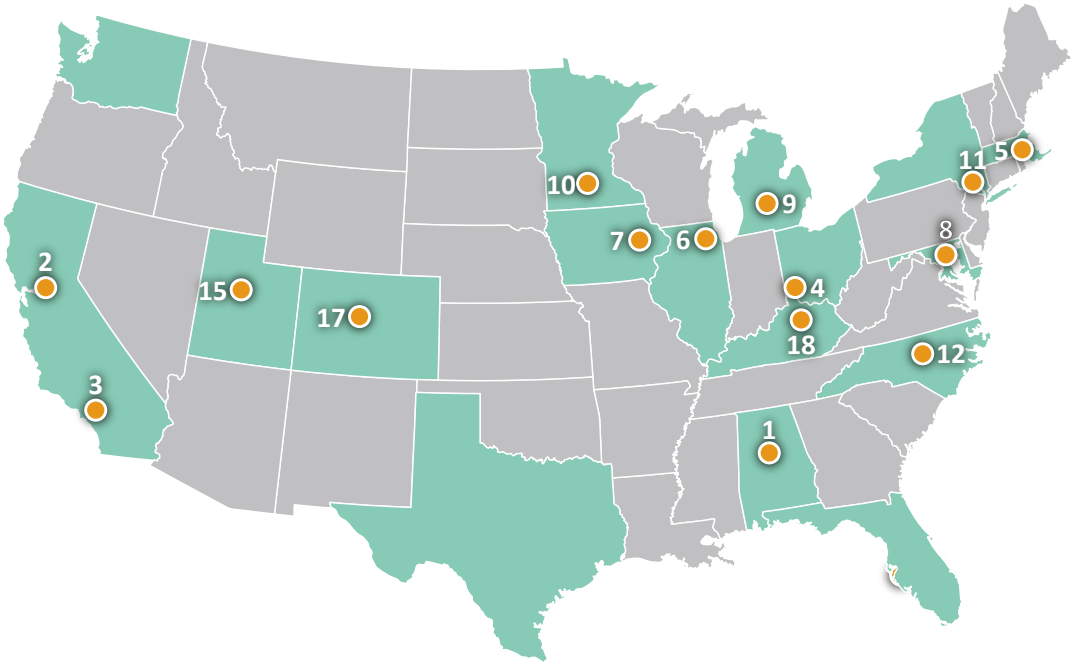
The Center for Work, Health, and Wellbeing's investigators at the Harvard School of Public Health have defined an integrated approach to worker health as "a strategic and operational coordination of policies, programs, and practices designed to simultaneously prevent work-related injuries and illnesses and enhance overall workforce health and well-being," building on the work of others in this area. Using this definition, they have developed a set of measures to evaluate the extent to which a worksite implements an integrated approach to worker and worksite health. The Veterans Health Administration used this instrument in a survey of small- to medium-sized businesses in one of the center's project.

4. Education and Research Centers

a. Overview

NIOSH supports professional training in occupational safety and health through training programs in Education and Research Centers (ERCs). ERCs are university-based, multidisciplinary centers that provide graduate training in the core and allied fields of occupational safety and health. ERCs also provide continuing education and outreach to the occupational safety and health community throughout the federal health region they serve. ERCs are interdisciplinary programs that address safety and health training and research training in a crosscutting and integrated manner. ERCs are the major part of a network of training grants that help ensure an adequate supply of qualified professional practitioners and researchers. Outreach and research-to-practice activities with other institutions, businesses, community groups, or agencies located within their region are essential ERC components. Programs are encouraged to address area needs and implement innovative strategies to meet those needs, with a focus on worker health and safety.

NIOSH Education and Research Centers by DHHS Region



1. University of Alabama, Birmingham
2. University of California, Berkeley
3. University of California, Los Angeles
4. University of Cincinnati
5. Harvard University
6. University of Illinois, Chicago
7. University of Iowa
8. Johns Hopkins University
9. University of Michigan
10. University of Minnesota
11. Mount Sinai School of Medicine
12. University of North Carolina
13. University of South Florida
14. University of Texas
15. University of Utah
16. University of Washington
17. University of Colorado
18. University of Kentucky

b. Public Health Relevance

The Occupational Safety and Health Act establishes the NIOSH mandate to conduct education programs to ensure an adequate and steady supply of qualified personnel in this discipline. NIOSH responds to this mandate by funding training programs in the core and allied disciplines of occupational safety and health to increase the number and competencies of the occupational safety and health workforce in the United States. NIOSH-funded Education and Research Centers are central to this mandate and serve a vital role in protecting and promoting the health and safety of the nation's workforce. Aligning with the goals of Healthy People 2020—to prevent diseases, injuries, and deaths that are due to working conditions—ERCs improve occupational safety and health through education, research, and collaboration. They are the regional and national resource on these issues for business, labor, government, and the public.

ERCs meet the critical need to produce researchers and practitioners—vital to maintaining workplace health and safety—and reducing the burden of preventable work-related injury, illness, and death by performing the following actions:

- Providing the U.S. workforce with the occupational safety and health expertise needed to reduce the burden of occupational injury, illness, and death.
- Developing the major research innovations needed to prevent occupational injuries and diseases in the United States.
- Providing regional and industry-specific outreach and consultation to more than 5,000 small-, medium-, and large-sized U.S. businesses annually.
- Serving as the primary source of accessible experts to the public and government leaders for occupational safety and health issues, while not duplicating any other U.S. government program.

c. Selected Program Highlights FY2014

Trainees, Graduates, and Employment of Graduates

In academic year 2013–2014, 300 students graduated from ERC programs with specialized training in disciplines that included industrial hygiene, occupational health nursing, occupational medicine, occupational safety, and other closely related occupational safety and health fields of study. This is an increase of 36% over the number of FY2013 graduates (n=190). The following table shows the number of students enrolled, graduates, and employment status during FY2014.

ERC Trainees, Graduates and Employment, FY2014

Program Area	Enrolled	Graduates	Employed or seeking occupational safety and health employment (%)
Industrial Hygiene	236	87	80 (92%)
Occupational Health Nursing	126	53	47 (89%)
Occupational Medicine	40	35	28 (80%)
Occupational Safety	62	28	26 (93%)
Other Related Disciplines	246	97	86 (89%)
Total	710	300	267 (89%)

ERC graduates work in a variety of industries related to occupational safety. The placement of FY2014 graduates is shown in the following table, by program area and work setting. Graduates who are seeking employment in the occupational safety and health field and have not taken employment outside their field are considered as remaining in the field.

ERC Graduate Employment by Work Setting, FY2014

Work Setting/ Program Area	Industrial Hygiene (n=87)	Occupational Health Nursing (n=47)	Occupational Medicine (n=28)	Occupational Safety (n=28)	Other (n=97)	Total (N=300)
Academic Institution	19	5	3	1	24	52
Clinic/Hospital	1	18	15	2	5	41
Federal Government	10	5	4	10	20	49
Private Industry	39	9	4	6	20	78
State/Local Government	4	1	0	1	4	10
Other Occupational Safety and Health Employment	3	0	0	6	6	15
Seeing Occupational Safety and Health Employment	4	9	2	0	7	22
Total	80 (92%)	47 (89%)	28 (80%)	26 (93%)	86 (89%)	267 (89%)

Continuing Education Outputs

A required component of ERCs is continuing education of occupational safety and health professionals. Each year, NIOSH ERCs train thousands of these professionals around the United States through course offerings in the occupational safety and health core and related disciplines. The following table shows the continuing education activity by discipline. In FY2014, the ERCs provided more than 430,000 person hours of training to more than 61,000 occupational safety and health professionals, through 2,256 courses.

Continuing Education Courses by Discipline, FY2014

Discipline	Number Courses	Number Trainees	Person-Hours of Training
Industrial Hygiene	234	5,473	54,736
Occupational Health Nursing	213	7,227	43,093
Occupational Medicine	204	9,005	53,673
Occupational Safety	1,281	17,063	160,436
Ag Safety and Health	31	1,047	7,347
Other	293	21,354	112,356
Total	2,256	61,169	431,641

The table below shows the distribution of continuing education training provided to occupational safety and health professionals by industry. Most continuing education trainees were from private industry (n=28,478). Among the four main disciplines of occupational safety and health, occupational safety courses had the highest number of trainees (n=18,100) followed by trainees attending other courses representing a range of content (n=21,354).

Continuing Education Trainees by Industry, FY2014

Industry	Discipline					
	Industrial Hygiene	Occupational Health Nursing	Occupational Medicine	Occupational Safety	Other	Total
Private Industry	2,691	3,215	5,077	8,246	9,249	28,478
Federal Government	543	432	344	696	1,573	3,588
State/Local Government	958	498	216	1,772	2,835	6,279
Academic Institution	1,045	872	3,069	2,804	3,421	11,211
Other	236	2210	299	4,592	4,276	11,613
Total	5,473	7,227	9,005	18,110	21,354	61,169

Leveraging Resources for Impact

The University of Utah's Rocky Mountain Center for Occupational and Environmental Health (RMCOEH) built unparalleled collaborative relationships. The RMCOEH teamed with businesses, employee groups, government agencies, and other community organizations to facilitate state-of-the art training for their occupational safety and health trainees. The Utah Center director worked with key stakeholders to gain support of Utah legislation to allow self-insured employers and workers' compensation insurance carriers to donate workers' compensation premium taxes to support the center. In 2012, the Utah legislature extended this program through 2020. These relationships with business and industry also provide external laboratories to develop innovations to provide safer and healthier workplaces.

The Mountain and Plains (MAP) ERC at the University of Colorado–Denver and Colorado State is in a region with a growing population, including large groups of underserved and minority workers. Many of the region's minority workers in agriculture are underserved. All-terrain vehicle (ATV) use increased in recent years. The increased use of ATVs led to an exponential rise in work-related fatalities of 193% between 1999 and 2008. The agricultural sector had the highest rate of work-related death at 65%—led by Montana in 2012. The MAP ERC collaborated with The High Plains Intermountain Center for Occupational Health and Safety (HICAHS) to certify more ATV safety trainers. Because of the HICAHS grant program, 11 agricultural extension agents received ATV Safety Institute training and certification. Extension agents can now give training on safe ATV use across Montana. This partnership with the Montana Workers' Compensation Assistance Bureau will help reduce work-related ATV injuries and fatalities among the ranching communities throughout Montana, and it will increase impact tracking.

Temporary Workers

At the University of Illinois at Chicago, several outreach efforts with Chicago Workers Collaborative (CWC), Arise Chicago, and Latino Union of Chicago (LU), successfully reached various segments of temporary workers. For example, Latino temporary workers from low wage/highly hazardous jobs in manufacturing received occupational health promoter training. The trainees participated in sessions to gain skills in assessing hazards and health issues of temporary employment in manufacturing (e.g., food processing, plastics, foundries, corrugated boxes). Also, in conjunction with ARISE Chicago, UIC staff codeveloped a Polish language curriculum on domestic workers' health and safety hazards. Collaborative safety training was also developed and conducted for temporary workers from various cultural backgrounds, including Latino workers, Asian American workers, and African American workers.

Workplace Violence

In an effort to lower work-related physical assaults against healthcare workers, the faculty and students at the University of Minnesota's Midwest Center for Occupational Health and Safety have collaborated to identify certain risk factors. Risks they found included working in environments with low lighting, not carrying cell phones or alarms, working

in emergency and psychiatric departments and long-term care facilities, and increasing hours of patient contact. The Minnesota ERC Center Director led efforts to disseminate research through many peer-reviewed publications and professional presentations. An online violence prevention course, *Prevention for Nurses* (CDC Course No. WB1865—NIOSH Pub. No. 2013-155) is now available because of the researchers' efforts. Nurses and other healthcare workers have a high interest in this global issue. A major international conference was held in Hong Kong in 2015. The Minnesota ERC Director will provide two relevant presentations at this conference.

Emerging Issues

Horizontal drilling and high volume hydraulic fracturing are contributing to the rapid job growth in the oil and gas industry. Occupational fatality rates are 2.5 times higher than in the construction industry and 7 times higher than general industry. However, significant gaps in knowledge have emerged, which cause increased concerns about the health and safety risks of workers in this industry. The MAP ERC, working with the University of Wyoming, NIOSH Western States Office, and other stakeholders, held a symposium to examine the state of the science and research needs of the oil and gas extraction industry. This symposium and peer-reviewed published report provide important guidance for future research to advance science and research to practice that targets protection of the oil and gas workforce. This led to publishing the first comprehensive review of the occupational safety and health research gaps in this industry and case studies illustrating challenges and potential solutions.*

The Education and Research Center at the University of Cincinnati has a dynamic Targeted Research Training Program that provides interdisciplinary research training in the framework of developing and transferring emerging technologies and methods to improve firefighters' health and safety. For example, a mechanical engineering student—working under the guidance of UC faculty—developed a finite element model of carbon nanotube fabric (CNF) integrated into firefighter garments, for evaluating CNF's ability to protect firefighters from external heat while at the same time dissipating body heat. This unique thermally anisotropic property of carbon nanotube fabric is being incorporated in prototype firefighter garments; if successful, it will significantly help to minimize heat build-up during firefighting.

Selected Impacts of ERC Graduates

NIOSH support develops the next generation of health and safety professionals at the University of North Carolina (UNC) at Chapel Hill. A UNC NIOSH trainee, with faculty guidance, collaborated with a NIOSH industrial hygienist in hazard evaluations and field studies on a joint research project regarding dermal exposures to firefighters. They performed analyses of a series of exhaled breath samples collected from firefighters immediately before and after suppression of structural burns. This collaboration resulted in a

*Witter et al. [2014]. Occupational exposures in the oil and gas extraction industry: state of the science and research recommendations. Am J Ind Med *57*(7):847–856.

NIOSH report,[†] and a jointly authored scientific article published in the *Annals of Occupational Hygiene*.[‡]

B. Investigator-initiated Research

1. Research Grants

a. Overview

The goal of the NIOSH extramural research program is to support relevant and high-quality scientific investigation that reduces occupational disease and injury. NIOSH responds to that goal by funding investigator-initiated research. These diverse awards include funding for large occupational safety and health research projects (R01), small research grants (R03), and exploratory research grants (R21). The extramural research portfolio includes mentored research scientist development awards (K01) that provide mentored training for the next generation of occupational safety and health scientists. These highly competitive awards provide up to 3 years of funding and a scientific focus designed to develop the skills and productivity of new career scientists.

b. Public Health Relevance

Large Occupational Safety and Health Research Grants (R01)

The purpose of this funding opportunity is to develop an understanding of the risks and conditions that are associated with occupational diseases and injuries, to explore methods for reducing risks and for preventing or minimizing exposure to hazardous conditions in the workplace, and to translate significant scientific findings into prevention practices and products that will effectively reduce work-related illnesses and injuries.

Small Research Grants (R03)

This grant mechanism supports different types of projects, including pilot and feasibility studies; secondary analysis of existing data; small, self-contained research projects; development of research methodology; and development of new research technology. The R03 is intended to support small research projects that can be carried out in a short time with limited resources.

Exploratory Grant Program (R21)

The R21 mechanism is intended to encourage new exploratory and developmental research projects. For example, such projects could assess the feasibility of a new area of investigation or a new experimental system that has the potential to enhance health-related research. Another example could include the unique and innovative use of an existing methodology

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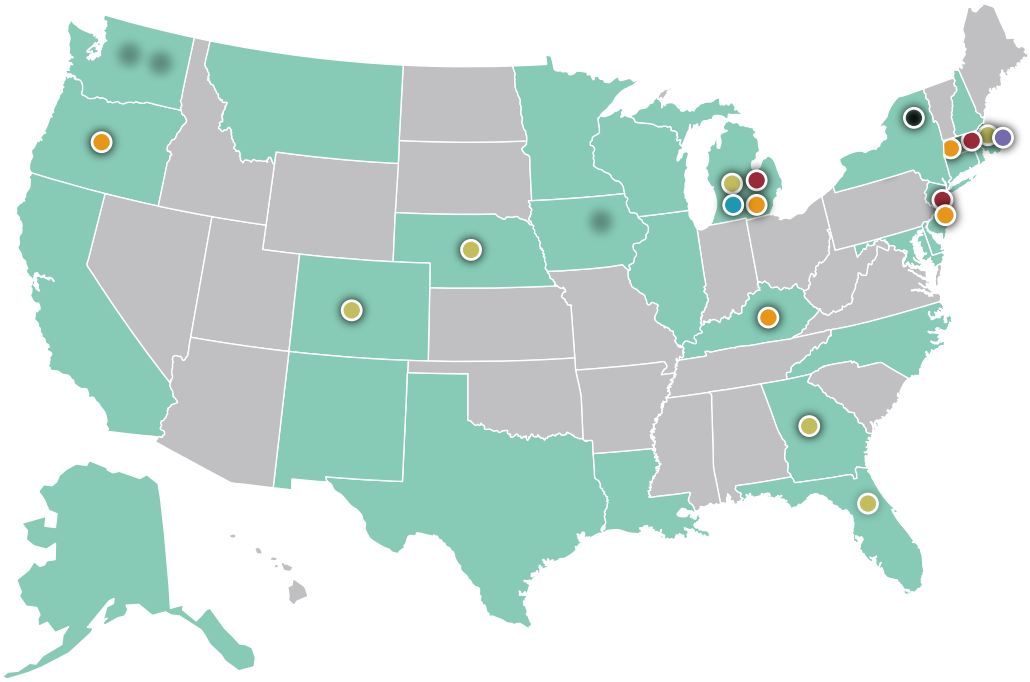
[†]NIOSH [2013]. Evaluation of dermal exposure to polycyclic aromatic hydrocarbons in fire fighters. By Fent, et al. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2010-0156-3196.

[‡]Fent et al. [2014]. Systemic exposure to PAHs and benzene in firefighters suppressing controlled structure fires. Ann Occup Hyg 58(7): 830–845.

NIOSH State Surveillance in Occupational Health



Fundamental and Expanded Programs

California
Connecticut
Colorado
Florida
Georgia
Illinois
Iowa
Kentucky
Louisiana
Maryland
Massachusetts
Michigan
Minnesota
Nebraska
New Hampshire
New Jersey
New Mexico
New York
North Carolina
Oregon
Texas
Washington
Wisconsin

Fatality Assessment & Control Evaluation

California
Iowa
Kentucky
Massachusetts
Michigan
New Jersey
New York
Oregon
Washington

BRFSS I & O Data Module

Colorado
Florida
Georgia
Massachusetts
Michigan
Nebraska
New Hampshire
New Mexico
Washington

Pesticide Poisoning

California
Iowa
Michigan
New York
Washington

Respiratory Diseases Projects

California
Massachusetts
Michigan
New Jersey
New York

California
Massachusetts
Washington

to explore a new scientific area. These studies may involve high risk/high reward that may lead to a breakthrough in a particular area or to the development of novel techniques, agents, methodologies, models, or applications that could have a major impact on a field of biomedical, behavioral, or clinical research. Applications for R21 awards should describe projects distinct from those supported through the traditional R01 mechanism. Projects of limited cost or scope that use widely accepted approaches and methods within well-established fields are better suited for the R03 small grant mechanism.

c. Selected Program Highlights FY2014

Highlights from R01 Grants

MICASA: Farm Worker Family Cohort Study (R01 9293, Schenker)

Hired farm workers face increased risks of morbidity and mortality from respiratory disease, musculoskeletal problems, infectious diseases, stress-related mental health disorders, and lifestyle-related diseases such as obesity. There has been limited research into the etiology of the poor health outcomes that occur disproportionately in this population. This study provided a longitudinal follow-up for a population-based cohort originally established in 2004–2006. The Mexican Immigration to California: Agricultural Safety and Acculturation (MICASA) Study evaluated a population-based sample of 400 hired farm worker families from Mendota, in California's Central Valley. The study provided estimates of disease incidence and changes in health-related behaviors over time (2008–2013) in the cohort of farm worker families.

Outcomes derived from this study included developing new heat-stress prevention programs, developing and testing new programs to reduce diabetes/obesity among farmworkers, and creating educational programs and interventions to improve dental health in this population. Findings from this study also gave more justification for newly proposed regulations to reduce heat stress in California. The project gave direct education to farm worker families through 30 monthly community meetings on a wide variety of topics, including pesticide exposures, air quality, heat-related illness, injuries, alcoholism, gangs and violence, cancer, tobacco education, and mental health. It provided educational sessions on heat stress to more than 130 farm workers, conducted spirometry testing and provided education and handouts explaining test results to more than 450 participants, and it tested for pesticide residue in 110 farm family homes. It reported education and test results to these families.

Occupational Exposure to PM2.5 and Cardiovascular Disease (RO1 9939, Cullen)

The research team was the first to develop an industrial job exposure matrix for fine particles (PM2.5) in a manufacturing plant. This was done by performing side-by-side total particulate and sized particle measures in 10 aluminum manufacturing facilities, for which extensive total particulate matter measures had been taken over three decades. In addition, the team used health insurance claims data to look at cardiovascular disease incidence. Through this research, the team linked health claims on an occupational cohort to Medicare claims. Through this work, the research team demonstrated that current exposure to PM2.5 causes a dose-related increase in the risk of ischemic heart disease in the workplace.

The team applied marginal structural models in this setting to adjust for demonstrated healthy worker selection bias away from exposure to particulate matter. The team successfully demonstrated differential dose-response relationships between aluminum smelting and fabrication activities, which are best explained by differences in particle-size distributions. This work provided equivocal evidence for a cardiovascular disease impact of cumulative exposure over time.

Implementing Risk Management Strategies to Prevent Injuries among Firefighters (R01 9469, Burgess)

This project used a proactive risk management approach to improve and implement injury prevention strategies. Among the goals was including standard operating procedures or guidelines to determine their effectiveness to reduce fire department workplace injuries. The project involved a close partnership with Arizona's Tucson Fire Department, which led to developing safety and health interventions and evaluating their effectiveness for a cross-section of commissioned Tucson Fire Department employees. The primary study included a 13% reduction in annual average injury frequency, a 30% decline in workers' compensation claims, and a 21% decline in average workers' compensation injury claims costs after the risk management process was implemented. The project website has a wealth of information on the research, including process information for other fire departments to use. This includes a short video explaining the risk management process and major findings.

Partnership to Improve Workplace Safety for In-Home Care Workers (R01 9080, Glass)

Consumer-driven homecare models that support aging and disabled people as they continue to live independently in their homes through the services of homecare workers are becoming more popular. These models increase the consumer's autonomy and control over services. Yet there is concern that these models may increase the exposure of homecare workers to workplace violence and harassment. The aims of this grant were to (1) determine the prevalence of and risk factors for workplace violence and harassment, (2) develop workplace training to address workplace violence and harassment, and (3) evaluate the effectiveness of the training.

The researcher developed training for homecare workers on preventing and responding to workplace violence and harassment. In the final study to evaluate the effectiveness of the training, 316 homecare workers were chosen randomly to participate in either (1) computer-based training, or (2) computer-based training with peer facilitation. All participants increased in knowledge and confidence to prevent and respond to workplace violence and harassment over time. In addition, all participants reported fewer incidents of workplace violence and harassment over time. Training through computer-based training only or computer-based training with peer facilitation are both effective approaches to reducing homecare workers exposure to workplace violence and harassment.

This study adds to the growing evidence that homecare workers are at high risk of occupational exposure to violence and sexual harassment, and it demonstrates that exposures are associated with negative health outcomes for employees. The major outcome of the study is

an evidence-based intervention to help homecare workers improve their knowledge, skills, and confidence to respond to workplace violence and sexual harassment. Little evidence was found to indicate that adding in-person peer training contributed to significantly better outcomes over time than computer-based training alone.

Highlights from R21 Grants

Promotoras and Hispanic Workers' Occupational Health in Post-Katrina New Orleans (R21 9605, Lara)

Hispanic construction workers, particularly foreign-born workers who have immigrated recently, experience a variety of adverse working conditions. They have lower rates of health insurance, lower rates of unionization, lower hourly wages, lower educational levels, fewer years of construction experience, and they tend to be concentrated in lower skilled and more hazardous occupations, such as day laborers and roofers. Dr. Marielena Lara of RAND Corporation worked with the local Common Ground Health Clinic in New Orleans, LA, to develop programs to address the needs of Hispanic workers who helped rebuild the city after Hurricane Katrina and then stayed on in the area as day laborers. A brief educational video featuring a male (promotor) and female (promotora) community health worker was developed and piloted by a joint investigator-community team to promote its feasibility and acceptability. The goal of the video intervention was to improve Spanish-speaking day laborers' knowledge and use of preventive behaviors regarding occupational health risks. The video intervention was associated with reported improvements in occupational knowledge and intent to engage in preventive behaviors among Hispanic day laborers. The video produced for the intervention will be shared with OSHA's Directorate of Construction, which reviewed the script before production and offered to disseminate the final product and findings through its website.

Development of a Microfluidic Paper Analytical Device (μPAD) for Airborne Metals (R21 10050, Volckens)

Despite the high incidence and prevalence of occupational respiratory disease, the paradigm for assessing exposure to occupational aerosol hazards has remained largely unchanged over the past 25 years. This paradigm, designed to support monitoring for regulatory compliance, is costly and takes time, because collected samples must be shipped or transported to a laboratory for subsequent gravimetric or chemical analysis. Making the issue harder to address, current exposure assessment methods for many of these hazards lack sufficient detection sensitivity. These limitations can prevent the practicing industrial hygienist from determining the source of a particular hazard, or whether or not a hazard even exists. Consequently, there is a critical need to improve the sensitivity and timeliness of methods for aerosol exposure assessment in occupational settings.

This project developed a new technology to quantify exposure to airborne metals in the workplace. The new technology is based on analytical devices that use microfluidic paper. These devices consist of a miniature capillary circuit printed onto ordinary filter paper, allowing precise analytical chemistry to be conducted directly on the collected sample. This work developed devices for in-situ analysis of many metals (Pb, Cu, Mn, Ni, Fe, Cr, Zn, and Cd). This new form of analytic chemistry costs less than $1 per assay, and yet it

was sensitive and specific enough to provide results comparable with the current state-of-the-art at a fraction of the cost.

A potential outcome from this work is for these assays to allow same-day, in-field exposure assessment for metals. Once this technology is commercialized, it will allow low-cost, high-throughput screening of exposures at much larger scales and at reduced costs. More efficient and timely monitoring will lead to improved hazard detection, which will naturally lead to improved hazard control and worker health.

Advancing Community-Based Occupational Safety and Health Intervention (R21 9955, Tsai)

This research focused on interagency networks for advancing community-based occupational safety and health intervention research focusing on Chinese and other immigrant health, employment, and related job concerns. Using worksite interventions, an effective occupational health approach for promoting worker health, has not been highly effective in addressing health and safety for immigrant workers. Dr. Tsai, et al., examined six types of connections (services, referral, etc.) among 36 agencies and community-based organizations in King County, Washington. The researchers observed that interagency interactions existed primarily through sharing of information relevant to Chinese immigrants' health, employment, and job-related needs. A small number of public agencies, service agencies, and nonprofits were the main "senders" of information. Knowledge generated from this project will identify and guide strategic choices in order to facilitate community-based partnership development and dissemination of comprehensive, sustainable prevention programs for immigrant workers. The relevance of network analyses and procedural knowledge generated by this project provide a model for community work with other ethnic minority and immigrant worker populations to address occupational health disparities.

Highlights from R03 Grants

Improving Dissemination of a Retail Workplace Violence Prevention Program (R03 10058, Casteel)

Previous research by Casteel et al., 2008, has shown that simple, low-cost changes to the store environment can effectively reduce a small retail business's risk of robbery and violent crime; however, these changes are only effective if the owner or manager ("business operator") decides to undergo training and implement them. This research addresses the gap between effective programs for workplace violence prevention and business operator participation in them. Interviews with business operators and representatives of influential organizations (e.g., Chambers of Commerce, economic development agencies, insurance agents) have revealed several strategies for engaging business operators in programs for workplace violence prevention. By implementing these program design and promotional strategies, practitioners of workplace violence prevention may be able to recruit more operators of small retail businesses to take steps to reduce their risk of workplace violence.

This research has identified that small businesses experience barriers to participating in an evidence-based program for preventing workplace violence. It has identified measures to

overcome these barriers and maximize program uptake. This work fills critical gaps in the area of preventing workplace violence, with a focus on businesses in the retail industry at high risk for robbery and robbery-related employee injury—specifically small businesses. The NIOSH NORA committee representing the Wholesale and Retail Trade sector has identified violence prevention as a priority, and it has identified the need for better translation and dissemination strategies. In addition, the NIOSH Small Business Assistance and Outreach cross-sector has identified the need to improve outreach to small businesses within the Wholesale and Retail Trade sector by providing access to occupational safety and health programs. Methods from this study are broadly applicable to other occupational safety topics, thus contributing to NIOSH r2p initiatives.

C. Cooperative Research Agreements

Cooperative agreements provide NIOSH with the ability to arrange collaborative surveillance and research opportunities with state health departments, universities, labor unions, and nonprofit organizations. NIOSH provides funding for a broad array of cooperative agreements to develop knowledge that can be used in preventing occupational diseases and injury. In FY2014, NIOSH funded the state surveillance program to support capacity development among states to conduct surveillance of occupational injuries, diseases, deaths, and hazards. NIOSH also continued support of the National Mesothelioma Virtual Bank and the construction cooperative agreement. This center performs integrated and multidisciplinary construction research and research to practice.

Unlike grants that are conducted independently of the sponsoring agency, cooperative agreements bring together the expertise of federal and nonfederal researchers to accomplish public health efforts that would not otherwise occur. In order for a cooperative agreement to be awarded, there must be a clear need for programmatic staff involvement during performance of a proposed project. An evaluation is made to determine that the cooperative agreement is of sufficient priority to warrant the commitment of staff resources required for a collaborative effort during the term of the cooperative agreement award.

1. State Surveillance Program

a. Overview

The state surveillance program supports the capacity development among states to conduct surveillance of occupational injuries, diseases, deaths, and hazards, and it helps expand the role of states in conducting in-depth surveillance and follow-up investigations and interventions. These local state-based skills and abilities help meet the NIOSH mandate to ensure a safe workplace. See the State Surveillance Portfolio Annual Performance Reports for more information on these state-based initiatives.

b. Public Health Relevance

The NIOSH surveillance research program acknowledges and values the contribution of state programs in occupational safety and health surveillance. NIOSH provides financial and technical assistance to state health and labor agencies to develop and expand capacity for programs dealing with occupational health surveillance. The extramural surveillance

portfolio comprises 23 state recipients, encompassing 49 projects, for addressing work-related morbidity and mortality, exposures and hazards, and special worker populations of interest. These programs' overall goals include using and disseminating occupational health surveillance data for identifying the incidence and prevalence of occupational injuries, illnesses, deaths, and exposures; identifying occupational health surveillance trends, research opportunities, emerging issues, high-risk worker populations; creating and disseminating targeted educational and prevention materials for optimizing their uptake or adaptation for protecting workers; and conducting outreach and engaging partners in public health and safety for advancement of "data into action."

c. Selected Program Highlights FY2014

Preventing Injuries Electronically

The State Occupational Health and Safety Surveillance Program moved data to action in FY14 by launching state-specific electronic newsletters to help prevent work-related illness, injury, and death. Newsletter topics ranged from preventing asthma from chemical exposure, to preventing fatal injury among tree-care workers and trimmers. Other topics included ergonomic risks; falls, especially in construction; infectious, communicable, and other diseases; trucking-related hazards; and issues for temporary-status workers. Like their content, the newsletters' audience was diverse, including health and safety advocacy or community-based groups; employers; safety professionals; researchers; temporary employment organizations; and, of course, workers and their representatives. In addition to informing their state workforces, the newsletters helped bring occupational public health into the arena of broader public health, especially for crossover topics, such as injury prevention and a sustainable, competent workforce.

Each state program has a unique story to tell:

Iowa: Emergency Action Plan for Local Businesses

University of Iowa graduate students in occupational and environmental health drafted emergency escape plans for 12 local businesses based on the Iowa Occupational Health and Safety Surveillance Program's Fatality Assessment and Control Evaluation (FACE) report, "Convenience store cook died from smoke inhalation."

Michigan: Temporary Staffing Agencies and Worker Protection

To help prevent work-related injury and illness among temporary workers, the Michigan Occupational Health and Safety Surveillance Program (Michigan OHSSP) produced three educational documents, based on its Temporary Employment Agency Survey, and sent them to the state's 477 temporary employment agencies. The documents include "Temporary Workers Hazard Alert; Guidance Sheet on Safety and Health Responsibilities of Host Employers and Temporary Staffing Agencies," and "Safety and Health Resources for Temporary Staffing Agencies."

Asthma Surveillance

Since the Michigan Occupational Health and Safety Surveillance Program (Michigan OHSSP) began in 1988, the number of Michigan residents with

work-related asthma caused by exposure to hazardous substances has decreased. The Michigan OHSSP complements other agencies' enforcement efforts through educational outreach to companies, physicians, and employees to prevent asthma related to hazardous substances, including isocyanates, metalworking fluids, and low molecular-weight agents.

Burns Surveillance

The Michigan OHSSP identified 515 work-related burns in the state and made 108 referrals for workplace safety investigations. These referrals led to 22 workplace investigations by the Occupational Safety and Health Administration (OSHA). The Michigan OHSSP also completed its second annual report, summarizing 2010 data, which it presented at the NIOSH Conference on the Use of Workers' Compensation Data for Occupational Safety and Health. The report was published it in the conference proceedings.

New Hampshire: Partnering for Prevention

The New Hampshire Occupational Health and Safety Surveillance Program (New Hampshire OHSSP) published a fact sheet, "Asthma and Cleaning Products—What Workers Need to Know," with the New Hampshire State Asthma Collaborative and the New Hampshire Asthma Control Program. Other collaborators included the New Hampshire Lung Association, Breathe New Hampshire, the Occupational Safety and Health Administration (OSHA) consultation group, the climate adaptation program, and the Asthma Control Program. Translated into four languages, the fact sheet met the objectives of the State Asthma Plan to increase knowledge and skills of adults with asthma, employers, and others to reduce exposures to environmental triggers, maintain healthy workplaces, and improve asthma management. A community-health center, located in an area where most of the state's immigrant population lives, now keeps the fact sheet as part of its electronic medical-record system for its clients, many of whom work in cleaning jobs. The fact sheet also is on the New Hampshire OHSSP website.

New Jersey Collaborating to Communicate Silica Hazards from Cutting Engineered Stone Countertops

In New Jersey, and worldwide, cut stone and stone-products manufacturing for home and commercial building products is increasing, with the number of employees and establishments nearly doubling in the past decade. Following a NIOSH-OSHA hazard alert about silica exposure from stone cutting and manufacturing, the New Jersey Occupational Health and Safety Surveillance Program (New Jersey OHSSP) collaborated with NIOSH engineers to develop engineering controls for silica dust from stone countertop fabrication and installation. Other collaborative activities included the NIOSH science blog, "Silica Hazards from Engineered Stone Countertops" and a case report in the February 13, 2015 issue of the Center for Disease Control and Prevention's *Morbidity and Mortality Weekly Report*. This case report, "Notes from the Field: Silicosis in a Countertop Fabricator—Texas, 2014," stemmed from the first reported case in the United States of silicosis from this type of exposure.

North Carolina: Working with Stakeholders to Prevent Carbon Monoxide Exposure

The North Carolina Occupational Health and Safety Surveillance Program (North Carolina OHSSP) expanded its carbon monoxide (CO) exposure-prevention initiative to identify high-risk industry sectors in the state. Using North Carolina National Toxic Substances Incident Program (NTSIP) surveillance data, the North Carolina OHSSP found that the largest proportion of work-related CO release incidents between 2002 and 2014 occurred at manufacturing worksites. Based on these findings, the North Carolina OHSSP developed four electronic fact sheets on recognizing, preventing, handling, and monitoring CO release in the workplace. The North Carolina OHSSP electronically posted the fact sheets and distributed them to workers and employees. They then conducted a follow-up survey to assess their use. The fact-sheet project stemmed from the North Carolina OHSSP's work with advisory group members affiliated with the North Carolina Department of Labor Occupational Safety and Health Division, and the North Carolina American Society of Safety Engineers (ASSE) Tar Heel Chapter, and manufacturing stakeholders.

Oregon: Preventing Residential Construction Fatalities

The Oregon Occupational Health and Safety Surveillance Program (Oregon OHSSP) examined the effectiveness of the traditional safety training, often called the tailgate, or toolbox, talk used in the construction industry. One source of information for these talks is the fatality, assessment, control and evaluation (FACE) report issued after a work-related fatality. To compare one-page supervisor talks with reports based on a full FACE report, the Oregon OHSSP analyzed three field studies aimed at preventing fatal construction falls. Both types of talks produced similar favorable worker reactions, perceptions of importance and urgency, and intentions to change behavior on job sites. The one-page guides, however, saved supervisors nearly 15 minutes of preparation and presentation time, compared with the FACE reports. The time savings led to further discussions of prevention recommendations, and 82 percent of supervisors and 66 percent of workers preferred the one-page format. Toolbox guides account for 25 percent of Oregon OHSSP website downloads, and, by mid-2014, the state FACE program had developed six new guides.

Wisconsin: Community-Based Interventions for New Public-Health Partnerships

The Wisconsin Occupational Health and Safety Surveillance Program (Wisconsin OHSSP) provided nine organizations with up to $8,750 each for 6-month community-based interventions. The Wisconsin OHSSP provided technical assistance to the studies, which ranged from farmer and first-responder training for farm accidents involving machinery and chemicals, to a community-needs assessment for occupational injury prevention and management. Other studies included agricultural safety outreach and education; targeted education, health screenings, and injury analysis, especially among dairy farm workers; large employers' workplace-wellness programs; and a comprehensive radon survey of a university campus. Already, these studies have led to increased collaboration between the Wisconsin OHSSP and local health departments, colleges and universities, and community-based groups. In addition, they helped promote new infrastructures for community occupational-health programs, resulting in sustainable projects beyond the funding period.

2. Construction Research (Virginia Tech)

a. Overview

The purpose of the 5–year cooperative agreement with Virginia Tech is to contribute meaningful applied research results and interventions that address construction safety and health knowledge gaps and research findings addressing several NORA Construction Sector research goals. Partnering institutions that lead or participate in individual research projects include Wake Forest University, Duke University, Pennsylvania State University, University of Wisconsin-Madison, Washington Department of Labor and Industries, Carpenters Trust of Western Washington, and the Royal Melbourne Institute of Technology (RMIT) University in Australia.

b. Public Health Relevance

The National Construction Center is an integrated, multidisciplinary force that revitalizes workers and industry through innovative safety and health research, translation, demonstration, and practice. This project had three aims: (1) documenting Latino construction workers' participation, attrition, and adherence to a 21-day protocol; (2) determining the quality of data collected from a daily process study design; and (3) identifying modifiable design features to improve feasibility of daily process study designs with immigrant Latinos.

c. Selected Program Highlights FY2014

Dust-control Usage: Strategic Technology Intervention

This project sought to create effective intervention strategies to improve adoption of prevention-through-design innovations in construction. For this project, a ventilated sanding tool, which reduces construction dust by 95%, was the Prevention through Design (PtD) innovation of interest. The researchers found that workers who went through the intervention expressed enhanced self-efficacy, trust in the ventilated tool, and willingness to use the tool in future work operations. Contractors who participated in the intervention demonstrated improved understanding of the risk of construction dust to workers, perceived ease of use and usefulness of the ventilated tool, and increased willingness to use the ventilated tool in future work operations. The collective effort of the researchers positively influenced "adoption readiness" for construction drywall finishing trade. Findings can be directly applied to improve construction worker safety and health and improve dust-control technology transfer to the drywall-finishing industry. Project-generated resources include 10 papers and presentations, a PtD conceptual model, validated survey instruments for the drywall finishing industry, intervention strategies and materials. All are available from Virginia Polytechnic Institute and State University, Office of Sponsored Programs.

Novel Optical Systems for Real-Time Welding Fume Monitoring (Active Status)

This research seeks to develop, using miniaturized microprocessor technology, three types of optical systems capable of real-time monitoring of the welding process. The technology laboratory-based study is a joint effort of researchers at Virginia Tech and Pennsylvania State University. The miniature optical sensor will detect the presence of nanoscale aerosols generated by the welding process, with high sensitivity for commercial silica fiber.

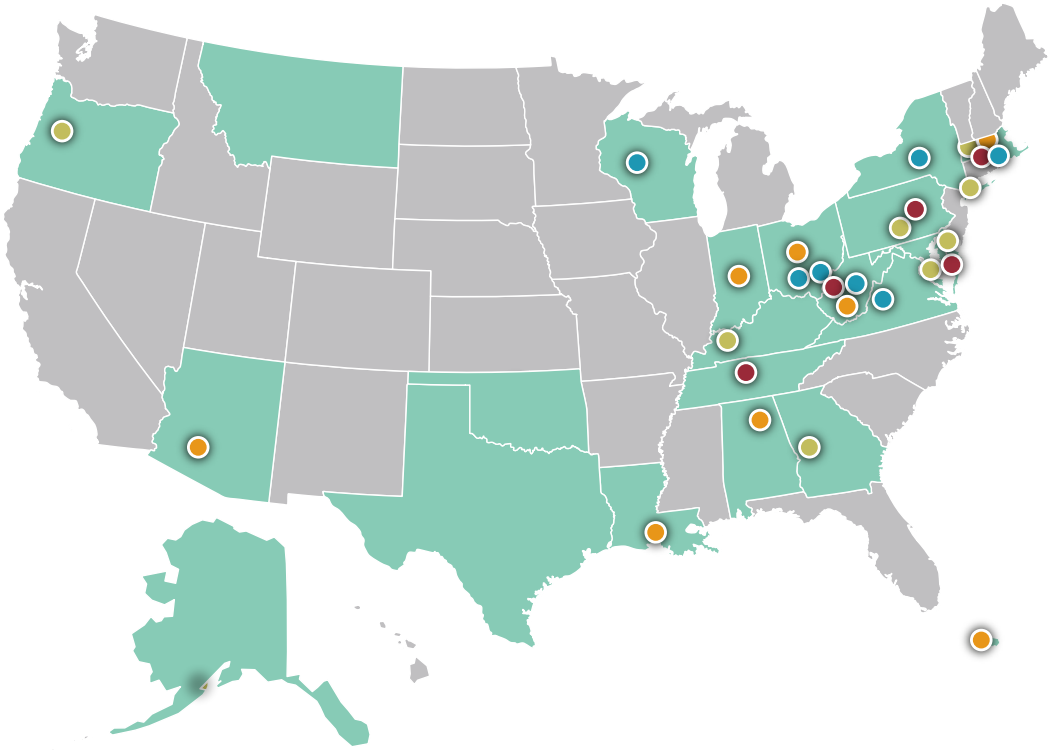
The investigators developed a sensitive Raman spectroscopy system for nanoscale particle sensing for welding aerosols. To date, the investigators successfully demonstrated repeatability of the emission spectrum measurements, and they are currently exploring methods to validate the results obtained from emission measurements. Activities continue regarding methodological and technological development for a wearable sensor for improving the health of construction workers who work in the presence of harmful nanoparticles generated during welding poses significant health concerns.

3. Training Project Grants

a. Overview

NIOSH supports professional training in occupational safety and health in single disciplines through Training Project Grants. These are individual academic training programs that support undergraduate and graduate training in a single discipline. These programs complement the national network of graduate training provided by ERCs, and they are located throughout the United States. In addition to traditional degree training program Training Project Grants, NIOSH also supports Training Project Grants that address the unique training needs of specialty groups. These include the Association of Occupational and Environmental Clinics (AOEC)'s Occupational Health Internship Program (OHIP). This program provides specialty training and increases diversity among the next generation of occupational health professionals by recruiting and mentoring students from minority and immigrant backgrounds including underrepresented minorities. The Alaska Marine Safety Education Association has a Training Project Grant that expands the network of port-based fishing safety instructors in Alaska and the United States through train-the-trainer curriculum designed for the unique needs of the commercial fishing industry.

NIOSH Training Project Grants by Discipline



Occupational Safety	Industrial Hygiene	Allied Occupational Safety & Health	Occupational Medicine
MA/Lowell	Arizona	Alaska Marine	MA/Lowell
Ohio State	MA/Lowell	AOEC	Meharry
SUNY/Buffalo	North Alabama	Connecticut	Pennsylvania
Texas A&M	Oklahoma	Emory	Texas/Tyler
Virginia Tech	Puerto Rico	IAFF	West Virginia
West Virginia	Purdue	MA/Lowell	Yale
Wisconsin/Stout	Toledo	Millersville	

b. Public Health Relevance

Training Project Grants are one of the principal means for NIOSH to provide the nation with an adequate supply of qualified professionals to carry out the Occupational Health and Safety Act of 1970. The nation's workforce is diverse, and Training Project Grants help train in specific disciplines where an identified need is being met. The graduates of Training Project Grants serve a vital role in protecting and promoting the health and safety of the nation's workforce, aligning with the goals of Healthy People 2020—to prevent diseases, injuries, and deaths that are due to working conditions. Occupational safety and health training is essential to eliminate these hazards and make the workplace safer and healthier for all workers. Training Project Grants are also important resources on occupational safety and health issues for business, labor, government, and the public.

c. Selected Program Highlights FY2014

Training Project Grant Trainees, Graduates and Employment by Discipline

In academic year 2013–2014, 228 trainees graduated from the Training Project Grant academic training programs with specialized training in industrial hygiene, occupational safety, occupational medicine, and allied disciplines in occupational safety and health. Allied disciplines included occupational health psychology, risk management, occupational ergonomics and engineering, environmental health, and occupational epidemiology.

Training project grant trainees, graduates and employment by discipline, FY2014

Program Area	Trainees	Graduates	Employed in occupational safety and health field or seeking advanced training
Industrial Hygiene	179	56	48 (86%)
Occupational Safety	508	101	101 (100%)
Occupational Medicine	31	16	15 (94%)
Allied Disciplines	91	55	52 (95%)
Total	809	228	216 (95%)

Reaching the Underserved

NIOSH trainees at the University of Oklahoma gained skills and competencies to reach underserved worker populations—specifically young workers and those working in service industries such as hair salons. In one outreach effort, a NIOSH trainee worked with the "SunWise" program during a fellowship. The program is relevant to the occupational exposure of young outdoor workers to solar radiation. This will potentially lead to sun-protective behavior throughout their working lifetimes.

Meharry Medical College is the largest, private, historically black institution dedicated to educating health-care professionals and biomedical scientists. At Meharry's accredited Occupational Medicine Residency Program, residents completed 1 month of training at community centers to gain valuable insight into the working conditionals and occupational health issues of migrant farm workers and their families. Meharry collaborated with Greene County Healthcare in Snow Hill, and the Center for Worker Health at Wake Forest University for this community outreach and research rotation.

High Caliber Trainees

The breadth of accomplishments by NIOSH trainees speaks to the quality of the Training Project Grants' academic standards. NIOSH trainees have co-authored peer-reviewed articles, performed original research, and made presentations at regional and national conferences, while completing rigorous academic studies in occupational safety and health.

At Emory University's Occupational Epidemiology Program, a NIOSH trainee is working on research related to time-series studies on acute effects of air pollution. The trainee has received two CDC awards for his research papers on cholera, including the James H. Nakano Citation for Standard for Scientific Excellence for Data Methods and Study Design (a center-level award from the National Center for Emerging and Zoonotic Infectious Diseases) and the CDC/ATSDR Charles C. Shepard Science Award for Data Methods and Study Design.

A NIOSH Industrial Hygiene trainee at the University of Oklahoma Health Sciences Center won a Phillips 66 SHIELD Scholarship. SHIELD scholarships are highly coveted. These scholarships go to undergraduate and graduate scholars who have an interest in careers in the energy industry. The student completed an internship with Phillips 66 and plans to do thesis research on crystalline silica exposure among concrete workers.

At the University of Pennsylvania's Occupational Medicine Residency Program, a resident was awarded the Resident Research Award at the AOHC for his work, "Characterization of the Healthy Worker Effect among Residents of the United States."

Occupational Safety and Health Workforce Development

NIOSH-supported trainees are graduating from Training Project Grants to go onto positions in local, state, and federal institutions contributing to workforce development. For example, a May 2014 MSPH graduate at Emory University is working at the state-level as an EPA/Emerging Infectious Diseases Laboratory Fellow at the North Carolina State Laboratory of Public Health. The trainee's research took an epidemiological approach to identifying microbial contamination of high-risk produce at various production points between the field and packing. The trainee, assisted by her faculty advisors, found the packing shed step, melons, and year of sample collection were significantly associated with microbial concentrations on produce. The research demonstrated the need for increased food safety interventions in the occupational handling of produce.

A Portland State occupational health psychology graduate took an OHP full-time position with the Washington State Bureau of Labor and Industries Safety and Health Assessment Program (SHARP). Also, Training Project Grants at Tulane and the State University of New York at Buffalo established pipelines for their trainees to enter government work at the federal and state occupational safety and health offices in their regions.

Occupational Health Internship Program

The Occupational Health Internship Program (OHIP) is unique because it provides Training Project Grant education for the next generation of occupational health professionals. OHIP reaches its goals through a dynamic recruiting and mentoring plan. Each OHIP trainee intern works in a field-based project to gain skills and knowledge in occupational safety and health for a summer. During this reporting period, OHIP continued to exceed its recruitment goals. Underrepresented minorities make up more than 38% of the interns.

OHIP developed and presented an inspiring 10-year anniversary video at the American Public Health Association (APHA) meeting. During the meeting, the APHA awarded

OHIP a special award for its work in placing interns in the field with workers. As a follow-up on OHIP's impact, a recent survey indicated that about 95% of survey respondents said OHIP influenced their educational or career path or their role in their current job. Many former OHIP interns now work at occupational and environmental federal and state agencies. Other former OHIP interns work in health and safety in academic or worker organizations. OHIP interns were greatly influenced by the internship experience and decided to pursue careers in nursing and medicine with a focus on occupational health. The OHIP experience provides interns an opportunity to work with workers in low-wage jobs with limited connection to occupational safety and health professionals.

4. Emergency Responder Training Program

a. Overview

NIOSH funds a unique Training Project Grant in Emergency Responder Training Program through the International Association of Fire Fighters (IAFF). The IAFF's mission through this program is to educate emergency responders about strategies to safeguard their health and safety, and reduce occupational injuries and deaths related to emergency response, so they can better protect the communities they serve. The IAFF has had a long working relationship with NIOSH and currently delivers training to all disciplines in emergency response: fire fighters, emergency medical personnel, law enforcement and public health. The IAFF's proven training record strongly emphasizes occupational safety and health as part of a comprehensive first responder training plan. IAFF's training seeks to fundamentally change knowledge, attitude, and behaviors, causing responders to adopt a safer approach to emergency response throughout their career. Training is conducted across the United States and U.S. territories.

b. Public Health Relevance

This federally funded training program provides an excellent model of a delivery system for training first responders. Using a cadre of instructors who are both certified fire service instructors and hazardous materials (HazMat) responders, the IAFF offers real-world training in HazMat response that few institutions can match. Furthermore, because the IAFF brings its training directly to the students in their own communities, the IAFF is able to tailor its presentations to address the unique concerns and challenges facing local responders. IAFF training is a proven resource that directly affects decisions made in real-world scenarios fire fighters experience every day, and they have developed training partnerships with thousands of fire departments throughout the United States.

c. Selected Program Highlights FY2014

The IAFF exceeded its projected goals for training in FY2014 and offered a total of 128 classes delivered to 2,854 students, with more than 53,904 contact hours.

Emergency Responder Training Classes, FY2014

Class Title	Duration	# of Classes	# of Students	# of Contact Hours
First Responder Operations	24 hour	65	1,407	33,560
Chemical Process Industries	8 hour	1	13	104
Illicit Drug Lab	8 hour	11	252	2,016
Emergency Response to Terrorism	8, 16, and 24 hour	42	1,017	15,128
Confined Space Operations	24 hour	9	165	3,096

The IAFF continues to use robust communications resources to promote NIOSH-funded training. This includes the IAFF website (401,000 visits/month), IAFF magazine (380,000 subscribers), the newly released IAFF App and the direct e-mail notification system (89,000 registered addresses). The IAFF's social media efforts include Facebook, Twitter, YouTube, Flickr, IAFF Frontline Blog, Google+, and Pinterest, with more than 122,000 "likes" on Facebook and 20,000 followers on Twitter. Through these social media channels, the IAFF engages audiences that include members, other unions and labor groups, politicians, the media, other fire service organizations, and fire fighter-friendly supporters.

6. Miner Safety and Health Training Program

a. Overview

Despite many technological and work environment advances, mining remains one of the most challenging and demanding occupations in the United States. Because of the many challenges in the mining industry, the focus areas for mining training must encompass a wide range of hazards and risks.

The mining community in the eastern United States is served by the MSHA Training Academy in Beckley, West Virginia. The training program in West Virginia is not easily accessible to miners in the Western United States, and certain aspects of western mining operations are not pertinent to operations in the east. To increase access to training and to address gaps related to western mining operations, NIOSH has supported miner safety and health training in the Western United States since 1999. For 2014, three programs were funded: the Colorado School of Mines, the University of Arizona, and the University of Texas at Arlington.

This training provides an integrated approach to reducing injuries to miners and other workers in mining operations and to translate research into workplace practices that (1) improve mining safety, (2) improve the safety and health of miners, and (3) enhance the safety and health of other workers involved in mining operations.

Major objectives are to provide a training program that (1) addresses the training needs of miners in the Western United States, (2) develops and delivers training to miners in the Western United States, (3) provides qualified instructors and faculty, (4) evaluates

training effectiveness and impact on reducing injuries and illnesses to miners, and (5) coordinates with existing training programs, such as those offered by MSHA and MSHA-funded state programs.

b. Public Health Relevance

The Miner Safety and Health Training Program provides critical safety and health training to protect workers in one of the most dangerous industry sectors in the United States. This program contributes to this overall goal by taking the following actions:

- Expanding the mission of NIOSH in protecting and promoting the health of mine workers. The trainings have improved work practices, reduced work-related injury and illness, and increased the understanding of safety and health practices in Western mine worksites.
- Increasing the safety focus, total-health awareness, and leadership competency of miners, front-line supervisors, superintendents, and managers representing operations throughout the United States, spanning all major commodity sectors in surface and underground mining, as well as contractors.
- Directing the focus of mine-rescue training toward learning actual rescue skills rather than mine rescue contest rules, resulting in team members being better prepared to respond to all types of emergencies.
- Training more than 9,000 miners and supervisors to date.

This program fills an important regional need by providing occupational safety and health training, mine emergency response and rescue training, and needs-based education to individuals and companies engaged in mining and exploration activities throughout the western United States. The program is particularly critical for underserviced populations working on mine sites, including contractors, suppliers, consultants, equipment manufacturers, and small mine operators.

The program designs and implements active learning strategies for mine safety training and has trained trainers across all commodity sectors throughout the Western United States on how to improve safety training. These activities increase capacity and improve the transfer of best practices to the workplace.

c. Selected Program Highlight FY2014

Creation of the Mining Institute for Supervisory Leadership (MISL)

The University of Arizona created the Mining Institute for Supervisory Leadership (MISL) at the request of the industry technical advisory committee (TAC). The MISL provides a venue for participants who are actively employed in mining to gain greater understanding of leadership characteristics, such as: "total health" approaches, supervisor roles, legal responsibilities, health and safety hazard identification and control, communication, resiliency, safety-focused competency development in risk anticipation, risk recognition, and risk reduction/mitigation on and off property (in the community), as well as pragmatic tools to resolve conflicts, manage time and tasks, drive culture change, and improve the delivery of training using effective adult learning techniques. This content was delivered via

1-to-2 hour modules taught by members of the TAC and UA Faculty over 2.5-day course sessions. At the end of the intensive 2-and-a-half day course, participants in the MISL were partnered with a mentor (from the TAC and UA faculty) who provides guidance and coaching while the participants undertake a Leadership Project, allowing them to apply their new knowledge and skills in their respective workplaces. The participants (mentees) return at the 6-month mark during the next MISL to present their projects and transition to becoming mentors to the next cohort of participants. The cohorts asked for more advanced training after they finished their first round of mentoring, so in 2013 the center created the Silver-Advanced Leadership Training (SALT). Extensive evaluations have been conducted, and the overall result was that 95% "agreed" or "strongly agreed" that they would recommend the course to others; 90–95% felt the course met their goals and that they would be able to apply what they learned in their workplace.

Realistic Scenarios for Serious Gaming Software for Use in Mine safety Training—"Harry's Hard Choices"

The Arizona center developed MineSAFE (Software Architecture for Mine Safety Education), a new platform to create "serious games" in mine safety education. In designing their platform, they performed a triangulated needs assessment that included product surveys, feedback from industry stakeholders, and informal user studies of existing training software. MineSAFE games can run on computer hardware ranging from middle-range laptops to higher-end workstations and virtual reality theaters, with support for interface devices that include keyboards, mice, gamepads, touch surfaces, and emerging gesture enabled interfaces.

The UA has created the NIOSH training exercise "Harry's Hard Choices" as a serious game. The center has tested the Harry's Hard Choices game and has received excellent reviews for the training's effectiveness. The current game contains nearly all of the content required for MSHA annual refresher training. The gaming platform is unique in mining, and it is being prepared for distribution for underground coal mining training.

Mine Rescue and Incident Command Center Training

A new component of the Colorado School of Mines (CSM) program training curriculum provides mine rescue and emergency response training that focuses on improving the capabilities of the incident command center structure in order to enhance greater effectiveness in decision-making and communication. In addition to classroom instruction, this training utilizes a number of different computer simulations that can be adapted to reflect specific types of mines and hazards. This training greatly complements the existing mine rescue training being performed at the CSM Edgar Experimental Mine and was also implemented in collaboration with UA's surface mine rescue training program. During the program year, the mine rescue training curriculum included 12 courses that comprised the following activities: incident command training, Edgar Mine rescue exercises, heavy lift exercises, technical rope rescue, fire brigade training, abandon mine training, and mine rescue training and competitions designed for students from multiple universities.

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