

NIOSH Extramural Research and Training Program

Annual Report of Fiscal Year 2013

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
National Institute for Occupational Safety and Health



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Foreword

I am pleased to deliver the FY2013 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 (OEP).

In this report you will find a description of the NIOSH extramural research and training programs that were active during FY2013 and information on the structure and function of the OEP. A review and summary of funding by program area and grant mechanism is presented with comparison data over the preceding 5 fiscal years. Activities of the extramural portfolio are described for each of the NIOSH multidisciplinary research centers, investigator-initiated research projects, and cooperative research agreements. And funding and activities are also provided 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.

This year's annual report includes a review of extramural research and training program activity by NORA sector program goals and a description of the new research integration initiative. Hyperlinks to the NIOSH website have been embedded throughout the report, providing instant access to additional, relevant data and information. The appendices provide data on the activities of the OEP during FY2013, including the listing or program announcements published during the fiscal year, and peer review meetings. Appendix 4 provides a detailed summary of the public health relevance and impact of our extramural portfolios.

We hope that 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 FY2013, NIOSH awarded \$94,477,560 in extramural funding. A total of 198 awards were made during the fiscal year, and the success rate for investigator-initiated research grants increased from 18% in FY2012 to 23% in FY2013.

A total of \$48,659,718 (52%) went to multidisciplinary research and training centers, followed by \$30,284,244 (32%) for investigator-initiated and career development research grants. Cooperative research agreements made up \$10,441,817 (11%) of the FY2013 portfolio followed by \$4,089,155 (4%) for individual training project grants and \$1,037,626 (1%) for small business innovation research projects.

Awards were made in the following categories: 35 (18%) to our multidisciplinary research and training centers, which include Agriculture Safety and Health, Construction, WorkLife, Education and Research Centers (ERC), and Mining Training Centers; 101 (51%) for investigator-initiated and career development; 29 (15%) for cooperative research agreements; 28 (14%) for individual training project grants; and 5 (3%) for small business innovation research.

Eighteen ERCs received approximately \$23 million in funding, followed by almost \$15 million for Agriculture Safety and Health Centers. Approximately \$6 million was awarded to the National Center for Construction Research and Training, and just over \$4 million was awarded to the Centers of Excellence to Promote a Healthier Workforce. Mining training centers received \$0.8 million in funds in FY2013. These centers received funding for both continuing and competing renewals.

Review of the 2013 fiscal year revealed that each NORA industrial sector met most of their strategic goals either through extramural or intramural research efforts. In FY2013, NIOSH-funded researchers published approximately 334 journal articles in relevant scientific journals, including two top-ranked journals: Journal of American Medical Association and Environmental Health Perspectives. The journal most frequently published in was the American Journal of Industrial Medicine (n=38). The number of publications increased from 292 in FY2012 to 334 in FY2013. The public health relevance and impact of active projects in FY2013 are described in Appendix 4.

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LIST OF ABBREVIATIONS

Sector Programs

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

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I. NIOSH Extramural Research and Training Programs

The [NIOSH Extramural Research and Training Programs](#) include diverse portfolios of investigator-initiated research, mentored research scientist development awards, training programs, and small business innovation research projects in occupational safety and health. Multidisciplinary education and research centers, state surveillance programs, and global occupational health initiatives complement the breadth and depth of extramural research and training at NIOSH.

MISSION STATEMENT

The mission of the NIOSH extramural research and training programs is to direct, support, and evaluate national occupational safety and health research to reduce work-related injuries and illnesses through a diversified research portfolio with broad public health impact in collaboration with global partners. This mission is led by the Office of Extramural Programs, which advocates for and supports projects in occupational safety and health research, training, and surveillance. Through partnerships we make the best science possible.

PURPOSE AND STRUCTURE

The purpose of the NIOSH extramural program is to support research and training projects that are focused on the reduction of workplace risk for injury, illness, and death. NIOSH extramural research covers a wide range of program areas. Collectively, these research projects address a myriad of complex issues and further the state of art and knowledge related to the causes and conditions of occupational injury, illness, and mortality. To better manage funded research and respond to the NIOSH mission to generate new knowledge in the field of occupational safety and health and to transfer that knowledge into practice for the betterment of workers, the extramural research portfolio has been organized into six major categories of funded activities: (1) investigator-initiated research, (2) training programs, (3) multidisciplinary centers, (4) state surveillance programs, (5) small business innovation research, and (6) global occupational health initiatives. Descriptions of these program areas are available in the appendices and additional information can be found at [Research and Training Portfolios](#) on the OEP webpages.

ORGANIZATION AND STAFFING OF OEP

To facilitate the management of the extramural grant and cooperative agreement portfolios, NIOSH established the Office of Extramural Programs (OEP). OEP is under the leadership of the Associate Director for Research Integration and Extramural Performance, which reflects the Institute's commitment to integrating research activities across NIOSH and to assessing extramural research performance. OEP is organized around the four core

functions of review, program, performance measurement, and management. A listing of [OEP staff](#) is available on the NIOSH website.

GRANTS POLICY AND MANAGEMENT

NIOSH utilizes the National Institutes of Health (NIH) model for the administration of its extramural program. This allows NIOSH to partner with other components of the U.S. Public Health Service to support occupational safety and health research. This system also ensures that high-quality research is funded through the two-step peer review process, which evaluates scientific merit and programmatic relevance of proposed research projects. The peer review and program management of the extramural portfolios is managed by OEP. Please see [Appendix 1](#) for a list of the peer review meetings conducted by NIOSH in FY2013.

FUNDING OPPORTUNITIES

NIOSH announces its extramural research, training, and conference support programs in the [NIH Guide for Grants and Contracts](#). To maximize the grants program's usefulness in protecting workers, NIOSH funds projects that are both scientifically sound and related to program priorities. Prevention is the thrust of the research program, and studies are supported to identify occupational populations at risk, develop methods for measuring exposures to hazards and detecting adverse health effects, determine the prevalence and incidence of occupational hazards, understand the etiology of occupational diseases and injuries, and reduce or eliminate exposures to hazards. Support is provided for both laboratory and field studies involving humans, as well as laboratory studies with various animal models and cell lines. Acute, subchronic, and chronic investigations are supported. Methods development involves measurement instrumentation, analytical techniques, medical monitoring procedures, and statistical designs to improve accuracy and precision of results. Fundamental or basic research may be supported if the applicant describes in the proposal the current or potential utility of the research effort in dealing with an occupational safety or health concern. For more information on how to apply for these grants, please see "[Funding Opportunities](#)" on the NIOSH Extramural Research and Training Programs webpage. Please see [Appendix 2](#) for a list of all the grant activity mechanisms NIOSH uses and [Appendix 3](#) for a list of the NIOSH Funding Opportunity Announcements published in FY2013.

FUNDING PRIORITIES

To better coordinate the research activities in OEP, the extramural research portfolio is organized into priority areas in occupational safety and health. These research priorities are derived from 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. The NIOSH program portfolio is organized around the 10 NORA sector programs and 24 cross-sector programs that 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. Extramural researchers are asked to identify the priority areas their projects address. 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 below.

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 Cross-sector Program Areas

Authoritative Recommendations	Nanotechnology
Cancer, Reproductive, and Cardiovascular Diseases	Occupational Health Disparities
Communications and Information Dissemination	Personal Protective Technology
Economics	Prevention Through Design
Emergency Preparedness and Response	Radiation Dose Reconstruction
Engineering Controls	Respiratory Diseases
Exposure Assessment	Small Business Assistance and Outreach
Global Collaborations	Surveillance
Health Hazard Evaluation	Total Worker Health
Hearing Loss Prevention	Training Grants
Immune and Dermal Diseases	Traumatic Injury
Musculoskeletal Disorders	Work Organization and Stress-related Disorders

Research to Practice (r2p)

Priority is also given to projects that include “Research to Practice” (r2p) goals. r2p is 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 is continuing to work with

our partners to focus research on ways to develop effective products, translate research findings into practice, target dissemination efforts, and evaluate the effectiveness of these efforts in improving worker safety and health. More information on the NIOSH r2p Program can be obtained at <http://www.cdc.gov/niosh/r2p/>.



II. NIOSH Extramural Research Activity

FUNDING DISTRIBUTION FY2013

In FY2013, NIOSH awarded 94,477,560 in extramural funding. The distribution of awards by type of activity is shown in Figure 1. Fifty-two percent (52%) of the extramural funding went to multidisciplinary research and training centers, followed by 32% for investigator-initiated and career development research grants. Cooperative research agreements made up 11% of the FY2013 portfolio, followed by individual training project grants (4%) and small business innovation research projects (1%).

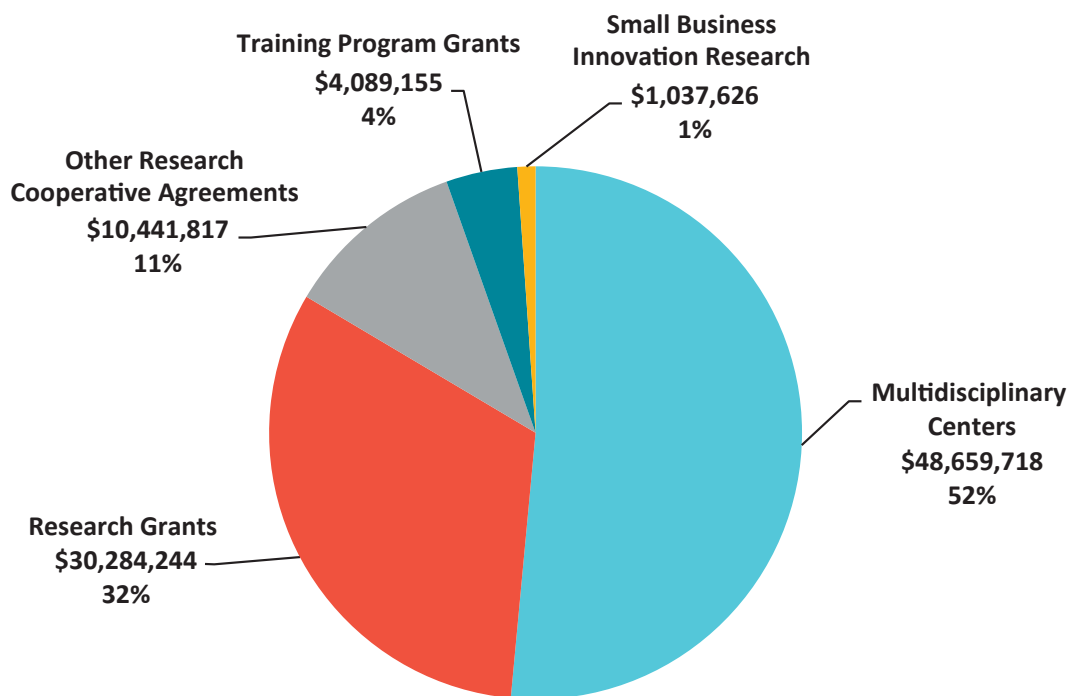


Figure 1. NIOSH extramural grant distribution, FY2013

In FY2013, NIOSH made a total of 198 awards. A summary of all the NIOSH extramural awards for FY2013 is shown in Table 1. Of the 198 awards made, 55 (28%) were for new projects and 143 (72%) were continuing awards. Awards were made in the following categories: 35 (18%) to our multidisciplinary research and training centers, which include Agriculture

Safety and Health, Construction, Work Life, Education and Research Centers (ERCs), and Mining Training Centers; 101 (51%) for investigator-initiated research, career development, and 5 (3%) for small business innovation research; 29 (15%) for cooperative research agreements; 28 (14%) for individual training project grants. 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 1. Summary of all awards by type of funding in FY2013

Award category	Award mechanism	Number of awards	Funding
Multidisciplinary Research Center		35	\$48,659,718
Education and Research Centers (ERCs)	Training Grant (T42)	18	\$23,005,303
Agriculture Safety and Health Centers	Cooperative Research Agreement (U54)	10	\$14,701,716
Construction Center	Cooperative Research Agreement (U60)	1	\$5,750,000
Work Life Centers	Cooperative Research Agreement (U19)	4	\$4,424,290
Western Mining Training Center	Cooperative Research Agreement (U60)	2	\$778,409
Investigator-initiated Research Grants		101	\$30,249,244
Research Grants	Investigator-initiated (R01, R03, R21, R13)	94	\$29,494,174
Career Developmental Research	Mentored Career Scientist (K01)	7	\$755,070
Other Research (Cooperative Agreements)		29	\$10,441,817
Surveillance	Cooperative Research Agreement (U60)	23	\$6,498,529
Hurricane Sandy	Cooperative Research Agreement (U19)	5	\$2,658,251
Virginia Tech	Cooperative Research Agreement (U60)	1	\$1,285,037
Training Program Grants		28	\$4,089,155
Training Program Grants (TPGs)	T01, T02, and T03	28	\$4,089,155
Small Business Innovation Research		5	\$1,037,626
Small Business Innovation Research	Phase I (R43) and Phase II (R44)	5	\$1,037,626
Total Extramural Funding		198	\$94,477,560

SUCCESS RATES FOR RESEARCH PROJECT GRANTS IN FY2007–FY2013

The success rate is the percentage of reviewed applications that receive funding on a fiscal year basis. The success rate is one of the measures of the viability of the research grants program. The success rate is significant to investigators because it is an indicator of the likelihood of funding. A low success rate may discourage investigators from applying to NIOSH-sponsored funding opportunity announcements (FOAs). While a lower success rate tends to discourage potential applicants, it also suggests that a large number of occupational safety and health research projects are in need of funding. The success rates for new awards are calculated only for the R01, R03, and R21 grant mechanism activity codes and do not include training grants or cooperative research agreements.

In FY2013, a total of 31 new awards (R01, R03, and R21 combined) were given out of 135 new applications (Figure 2). Since FY2007, the annual number of new applications has gone down from 192 to 135, while the overall success rate has gone from 17% to 23% over the same period. For FY2007–FY2013, the mean annual number of applications was 175, the mean number of awards was 33, and the mean annual success rate was 19%. For FY2010–FY2012, the number of applications reviewed stabilized (170–180). However, in FY2013, the number of applications decreased to 135.

In FY2013, the overall success rate for all three research grant applications (R01, R03, and R21) was 23%. The overall success rate had gone up from 18% in FY2012 to 23% in FY2013 (Figure 2).

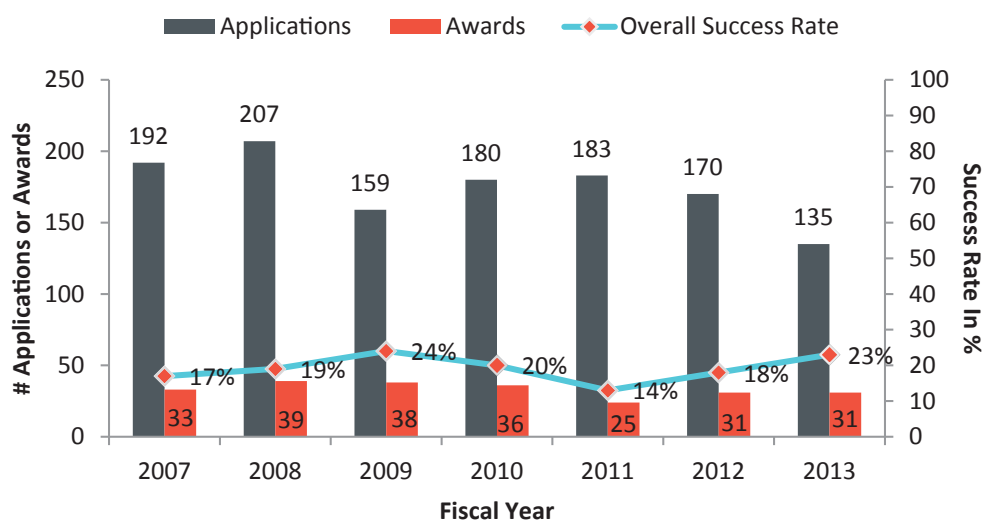


Figure 2. Overall success rates for research project grants (R01, R03, and R21), FY2007–FY2013

R01 Success Rates

Figure 3 shows the number of R01 applications and awards made annually from FY2007–FY2013. Success rates for R01 applications declined from FY2007–FY2012 but increased from FY2012 to FY2013. This may be because the number of applications reduced since 2009.

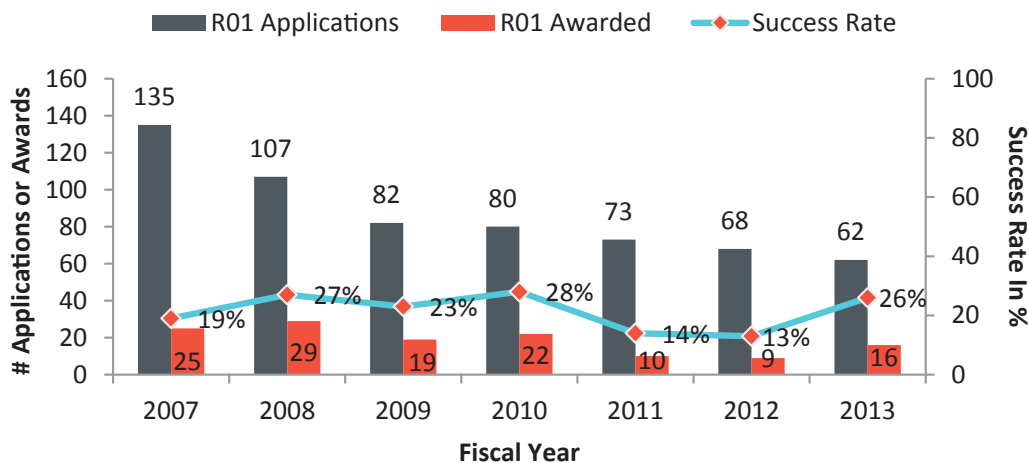


Figure 3. Success rates for R01 applications, FY2007–FY2013

R03 Success Rates

Figure 4 shows the number of R03 applications and awards made annually from FY2007 to FY2013. Success rates appear to have increased in 2009 to 30%. However, this is because the number of applications declined to 23 in 2009. Since 2009, the annual number of R03 applications has gone from 23 to 31 and the success rate stabilized to around 12%.

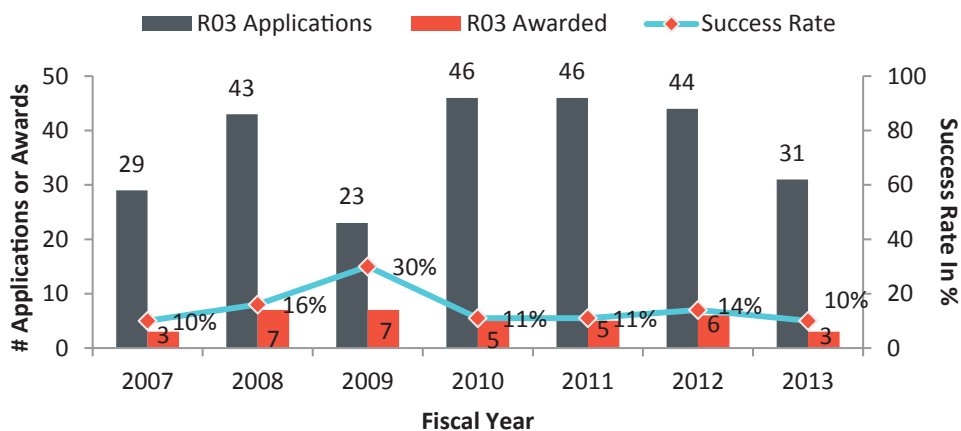


Figure 4. Success rates for R03 applications, FY2007–FY2013

R21 Success Rates

Figure 5 shows the number of R21 applications and awards made annually from FY2007 to FY2013. Success rates for R21 increased during FY2007–FY2013. The number of applications has increased from 28 in FY2007 to 42 in FY2013. The success rate has increased from a low of 5% in FY2008 to a high of 29% in FY2013.

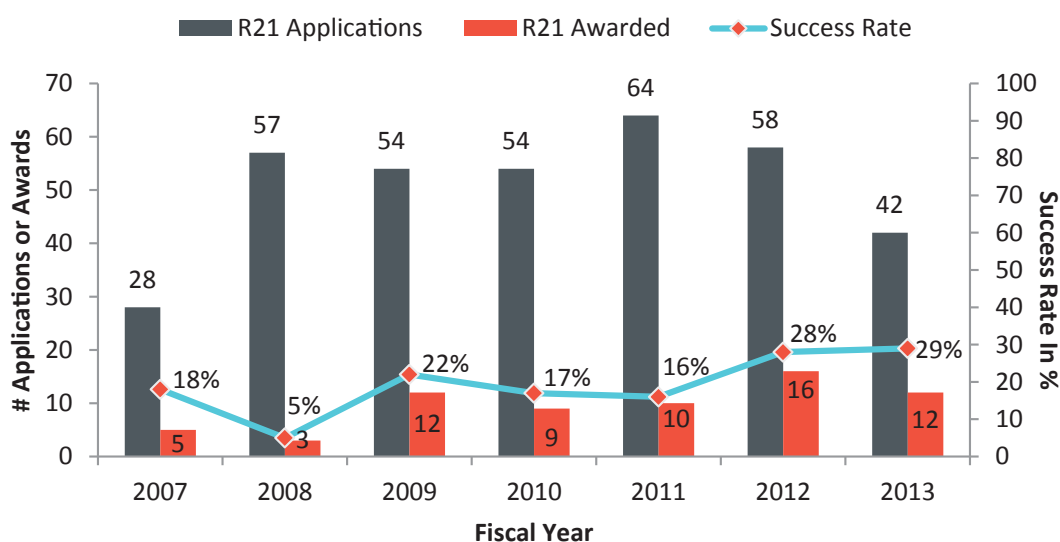


Figure 5. Success rates for R21 applications, FY2007–FY2013

EXTRAMURAL PORTFOLIO FY2013

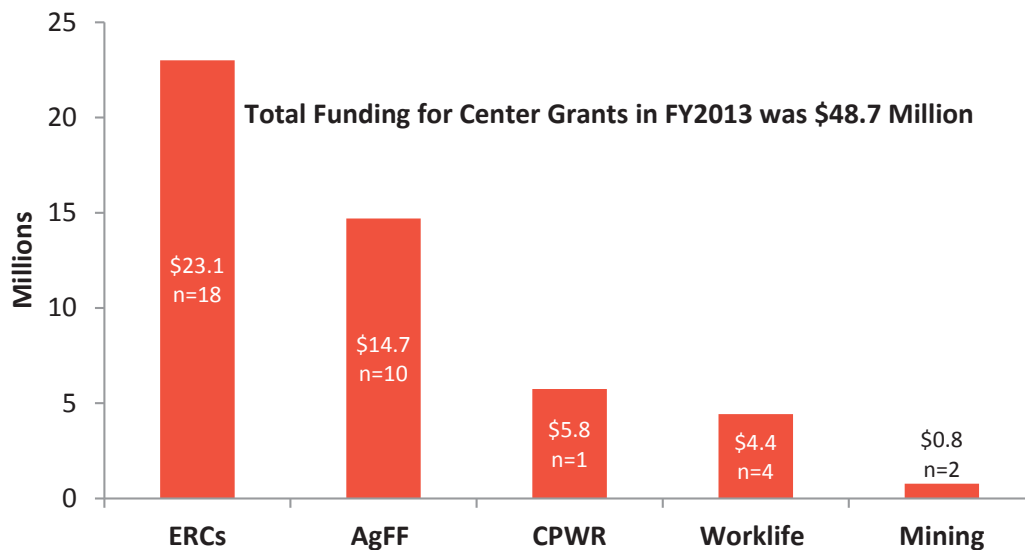
Multidisciplinary Centers

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](#) (formerly WorkLife Centers) 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. The Western U.S. Miner Safety and Health Training Program connect 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 [Mine Safety and Health Program](#) at the Colorado School of Mines.

A total of \$48.7 million was awarded to 35 multidisciplinary centers in FY2013. A total of 18 ERCs received \$23.1 million, with \$14.7 million awarded to 10 Ag Centers, \$5.8 million was awarded to the National Construction Center, 4 Total Worker Health Centers received \$4.4 million, and 2 Western mining centers received \$0.8 million (Figure 6). The centers provided support for education and research, agriculture, work life, mining, and construction. Figure 6 shows the FY2013 distribution of extramural center grant funding. A full description of each of these center portfolios, including a listing of individual center grants, is provided in [Appendix 4](#).



ERCs = Education and Research Centers; Ag Centers = Agriculture, Forestry, and Fishing;
 CPWR = National Center for Construction Research and Training;
 Worklife = Total Worker Health Centers; Mining = Mining Training Centers.

Figure 6. Multidisciplinary Center Awards, FY2013

Investigator-initiated Research

The goal of the NIOSH extramural research program is to support relevant and high-quality scientific investigation that will have an impact in reducing 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 (OSH) research projects (R01), small OSH research grants (R03), and exploratory OSH 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 \$30 million was awarded to new and continuing research projects and mentored scientist grants in FY2013 (Table 2). A description of investigator-initiated research outputs is provided in [Appendix 4](#).

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 FY2013 NIOSH funded one conference grant (see Table 2).

Table 2. Investigator-initiated research funding, FY2013

Type of grant	New awards	New funding	Continuing awards	Continuing funding	Total funding
R01	16	\$7,687,976	35	\$15,374,494	\$23,062,470
R21	12	\$2,801,872	15	\$2,827,244	\$5,629,116
K01	1	\$107,664	6	\$647,406	\$755,070
R03	3	\$215,075	6	\$447,513	\$662,588
R13	6	\$120,000	1	\$20,000	\$140,000
Total	37	\$10,932,587	74	\$19,316,657	\$30,249,244

Cooperative 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.

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.

NIOSH funded the state-based surveillance program to support the states in developing the capacity to conduct surveillance of occupational injuries, diseases, deaths, and hazards (see Figure 7). NIOSH also continued support of the Construction Cooperative Agreement. Five new awards were made in FY2013 to address Hurricane Sandy.

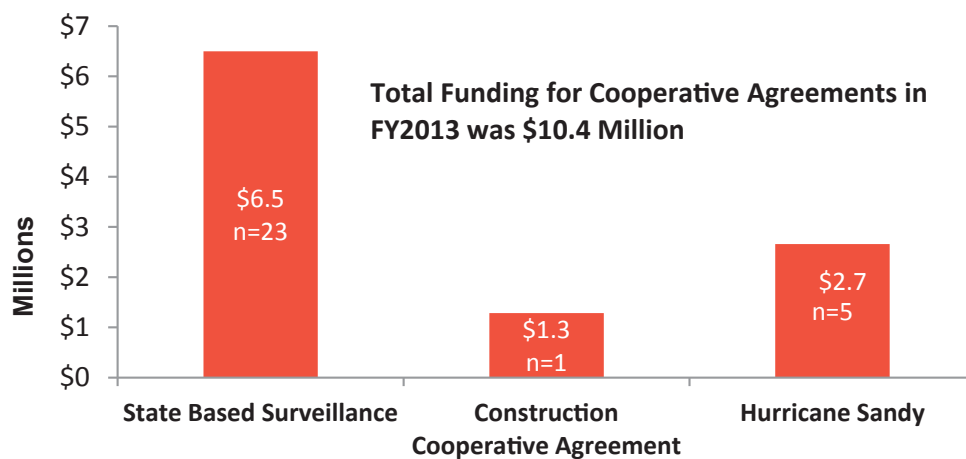


Figure 7. Cooperative Agreements, FY2013

Training Grants

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 (TPGs). TPGs are individual academic training programs that support undergraduate and graduate training in a single discipline. These programs compliment the national network of graduate training provided by ERCs and are located throughout the United States.

NIOSH funds a unique TPG—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 number and funding for all training grants (new and continuing) awarded in FY2013 are presented in Table 1.

State Surveillance Program

Our state surveillance program supports the capacity development among states to conduct surveillance of occupational injuries, diseases, deaths, and hazards and helps expand the role of states in conducting in-depth surveillance and follow-up 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 1 for the number and funding for all state surveillance awards (new and continuing) for FY2013.

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. This unique portfolio encourages participation by socially and economically disadvantaged small businesses and women-owned businesses to improve the return on investment from federally funded research for economic and social benefits to the Nation. SBIR Annual Reports provide regular updates on activities and outcomes. A diverse array of efforts are focused on research, information, and service for small businesses. Awards and funding for all FY2013 SBIR grants are presented in Table 1.

Global Health Initiatives

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, and (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 and partnership with the NIH Fogarty International Center. NIOSH has been the WHO Collaborating Center in Occupational Health for the United States since 1976 and has been involved in program planning, collaborative research, training, management, and direct staff interaction with WHO's Program on Workers' Health.

Since 1995, NIOSH has cosponsored international research training in occupational and environmental health through a very successful collaboration with the NIH's Fogarty International Center and the National Institute of Environmental Health Sciences (NIEHS). This co-sponsorship 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 NIEHS can be found at <http://www.fc.nih.gov/Programs/Pages/environmental-occupational.aspx>.

EXTRAMURAL RESEARCH ACTIVITY BY PROGRAM AREA

Extramural research activity in FY2013 was distributed across the NIOSH sector program areas. Figure 8 shows the distribution of funding for investigator-initiated research across NORA sectors in FY2012 and FY2013; a majority of awards funded pertained to the Manufacturing Sector, followed by All Sectors (Figure 8).

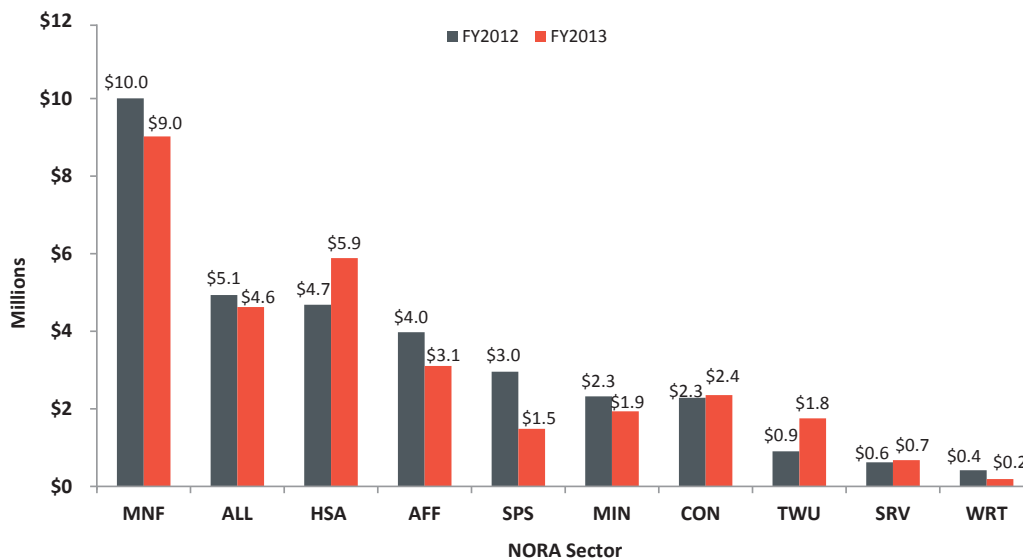


Figure 8. Research funding by sector program in FY2012 and FY2013

Extramural Research Funding by NORA Strategic Goals, FY2013

In order to better characterize NIOSH-funded research in FY2013, a review was conducted of the strategic goals related to extramural projects by NORA industry sectors. This data was obtained from the NIOSH Project Planning and Management System. Research projects may address multiple goals, and, as a result, the number of projects shown in Tables 3–12 do not sum to the total number of funded projects. These data include all extramural awards active in FY2013. A description of sector strategic goals can be found on the NORA webpage.

Table 3 displays the strategic goals addressed by extramural research projects in the Agriculture, Forestry, and Fishing Sector in FY2013. All nine strategic goals for this sector were addressed by extramural research projects in FY2013. Most of the projects addressed Surveillance (SG1, n = 32) and Agricultural Health (SG5, n = 23).

Table 3. Agriculture, Forestry, and Fishing Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all agriculture, forestry, and fishing projects
SG1: Surveillance	32	34
SG5: Agricultural Health	23	24
SG3: Outreach and Partnerships	13	14
SG2: Vulnerable Workers	12	13
SG4: Agricultural Safety	9	10
SG8: Commercial Fishing Injuries	2	2
SG6: Forestry Injuries	1	1
SG7: Forestry Illness/Disease	1	1
SG9: Commercial Fishing Illness/Disease	1	1

Table 4 displays the strategic goals addressed by extramural research projects in the Construction Sector in FY2013. Twelve of the 15 strategic goals for this sector were addressed by extramural research projects in FY2013. Most of the projects addressed Surveillance (SG14, n = 27).

Table 4. Construction Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all construction projects
SG14: Surveillance	27	36
SG7: Musculoskeletal Disorders	15	20
SG6: Welding Fumes	5	7
SG12: Health Disparities	5	7
SG5: Silica	4	5
SG13: Prevention through Design	4	5
SG1: Falls Prevention	3	4
SG9: Safety and Health Management	3	4
SG3: Struck-by Incidents Prevention	2	3
SG4: Hearing Loss Prevention	2	3
SG8: Safety and Health Cultures	2	3
SG11: Training and Education	1	1

Table 5 displays the strategic goals addressed by extramural research projects in the Healthcare and Social Assistance Sector in FY2013. All five of the strategic goals for this sector were addressed by extramural research projects in FY2013. The strategic goal most frequently addressed was Safety Culture (SG1, n = 12).

Table 5. Healthcare and Social Assistance Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all healthcare and social assistance projects
SG1: Safety Culture	12	48
SG2: Musculoskeletal Disorders	8	32
SG3: Hazardous Drugs and Chemicals	2	8
SG4: Sharp Injuries	2	8
SG5: Infectious Disease	1	4

Table 6 displays the strategic goals addressed by extramural research projects in the Manufacturing Sector in FY2013. Eight of the 10 strategic goals for this sector were addressed by extramural research projects in FY2013. The most frequently addressed strategic goals were Musculoskeletal Disorders (SG3, n = 13) and Respiratory Disease (SG5, n = 13).

Table 6. Manufacturing Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all manufacturing projects
SG3: Musculoskeletal Disorders	13	22
SG5: Respiratory Disease	13	22
SG9: Emerging Risks	11	19
SG6: Cancer	10	17
SG4: Hearing Loss	5	9
SG7: Vulnerable Populations	3	5
SG2: Falls	2	3
SG8: Small Business	1	2

Table 7 displays the strategic goals addressed by extramural research projects in the Mining Sector in FY2013. All seven of the strategic goals for this sector were addressed by extramural research projects in FY2013. The strategic goal most frequently addressed was Disaster Prevention (SG1, n = 7).

Table 7. Mining Sector awards by strategic goal, FY2013

Strategic goal (SG)	Number of projects	Percent of all mining projects
SG1: Disaster Prevention	7	24
SG2: Disaster Response	4	14
SG3: Illness	5	17
SG5: Behavior	5	17
SG4: Atmospheric Control	3	10
SG6: Design, Operations, and Management	3	10
SG7: Emerging Technologies	2	7

Table 8 displays the strategic goals addressed by extramural research projects in the Public Safety Sector in FY2013. Ten of the 16 strategic goals for this sector were addressed by extramural research projects in FY2013. The strategic goal most frequently addressed was Musculoskeletal Disorders (SG4, n = 4).

Table 8. Public Safety Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all public safety projects
SG4: Musculoskeletal Disorders	4	25
SG1: Chronic Disease in Fire Fighters	2	13
SG3: Vehicle-related Injuries in Fire Fighters	2	13
SG15: EMS Illness/Disease	2	13
SG2: Structural Firefighting Operations	1	6
SG5: Surveillance within Law Enforcement	1	6
SG8: Cardiovascular Disease in Law Enforcement	1	6
SG11: Occupational Studies in Correction Personnel	1	6
SG13: EMS Personnel Injuries	1	6
SG16: Surveillance in EMS	1	6

Table 9 displays the strategic goals addressed by extramural research projects in the Services Sector in FY2013. Five of the 17 strategic goals for this sector were addressed by extramural research projects in FY2013. The strategic goal most frequently addressed was Surveillance (SG16, n = 26).

Table 9. Services Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all service projects
SG17: Surveillance	26	68
SG16: Musculoskeletal Disorders	9	24
SG3: Health Disparities	1	3
SG4: Education and Schools	1	3
SG11: Violence in Food Services	1	3

Table 10 displays the strategic goals addressed by extramural research projects in the Transportation, Warehousing, and Utilities Sector in FY2013. All four of the strategic goals were addressed by extramural research projects in FY2013. The strategic goals most frequently addressed were Musculoskeletal Disorders (SG2, n = 7) and Chemical/Biological/Physical Hazards (SG4, n = 6).

Table 10. Transportation, Warehousing, and Utilities Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all transportation, warehousing, and utilities projects
SG2: Musculoskeletal	7	39
SG4: Chemical/Biological/Physical Hazards	6	33
SG1: Traumatic Injury	4	22
SG3: Health and Wellness Programs	1	6

Table 11 displays the strategic goals addressed by extramural research projects in the Wholesale and Retail Trade Sector in FY2013. Three of the six strategic goals for this sector were addressed by extramural research projects. The strategic goal most frequently addressed was Musculoskeletal Disorders (SG1, n = 7).

Table 11. Wholesale and Retail Trade Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all wholesale and retail trade projects
SG1: Musculoskeletal Disorders	7	54
SG3: Violence	4	31
SG6: Vulnerable Workers	2	15

Table 12 displays the strategic goals addressed by extramural research projects in the Oil and Gas Extraction Sector in FY2013. Three of the ten strategic goals for this sector were addressed by extramural research projects.

Table 12. Oil and Gas Sector awards by strategic goals, FY2013

Strategic goal (SG)	Number of projects	Percent of all oil and gas extraction projects
SG3: Falls	1	33
SG6: Chemical exposures	1	33
SG10: Small company incidents	1	33

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III. FY2013 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 FY2013.

SUMMARY OF PEER-REVIEWED PUBLICATIONS FOR FY2013

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, 2012, to September 30, 2013, there were 334 publications across 152 different journals. Table 13 shows the number of publications by funding activity. 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 = 38), followed by the *Journal of Occupational and Environmental Hygiene* (n = 19), the *Journal of Occupational and Environmental Medicine* (n = 17), and the *Annals of Occupational Hygiene* (n = 10). A searchable database of NIOSH publications can be found at [Grantee Award Final Reports and Publications on the OEP webpages](#).

Table 13. Number of publications by funding type, FY2013

Funding type	Number of publications
Research Project Grants (R01)	138
Education and Research Center Grant (T42)	71
Agricultural Safety and Health Center (U50, U54, U05, U07)	48
Small Research Grant (R03)	17
National Center for Construction Research and Training (U54 and U60)	16
World Trade Center (U01, U10, E11)	15
Exploratory Development Grant (R21)	14
Total Worker Health Center (U19)	10
State Surveillance Program (U60)	8
Mentored Research Scientist Development Award (K01)	7
Conference (R13)	5
Research Demonstration and Dissemination Grant (R18)	5
Education Projects (R25)	4
Construction Cooperative Agreement (U60)	4
Training Project Grant (T01 and T03)	3
Dissertation Award (R36)	1
Total	366

*Total number is greater than 334 publications because a publication could acknowledge more than one source of funding support.

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 to be more important than those with lower ones.

While 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. Table 14 shows the measures of impact factors for NIOSH-sponsored publications.

Table 14. Impact factor for NIOSH-sponsored publications, FY2013

Measure	Impact factor
Average (Mean)	2.777
Median	1.973
Mode	1.973
Minimum	0.34
Maximum	30.026

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 publications in FY2013 included the second-ranked journal in the field of medicine (*The Journal of the American Medical Association*, impact factor = 30.026) and the second ranked journal in the field of public, environmental, and occupational health (*Environmental Health Perspectives*, impact factor = 7.260).

OTHER EXTRAMURAL RESEARCH OUTPUTS

Other research outputs—including presentations, posters, published reports, proceedings, and books—were attributed to NIOSH-funded research in FY2013. These data are presented in [Appendix 4](#). Due to the inconsistencies in attribution, the number of outputs may be an underestimation of true productivity. Future efforts will provide clear guidance to researchers so that a more comprehensive listing of outputs can be provided.

IV. Research Integration in FY2013

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 our 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 indicates those goals that were addressed by either or both intramural and extramural research projects. In FY2013, all of the strategic goals were addressed in the following sectors: Agriculture, Forestry, and Fishing (AFF); Healthcare and Social Assistance (HSA); and Transportation, Warehousing, and Utilities (TWU). Most of the strategic goals in Construction (CON), Mining (MIN), and Manufacturing (MNF) were addressed by both intramural and extramural projects. In the Oil and Gas Extraction (MIO) and Services (SRV) sectors, most of the strategic goals were addressed by intramural research projects.

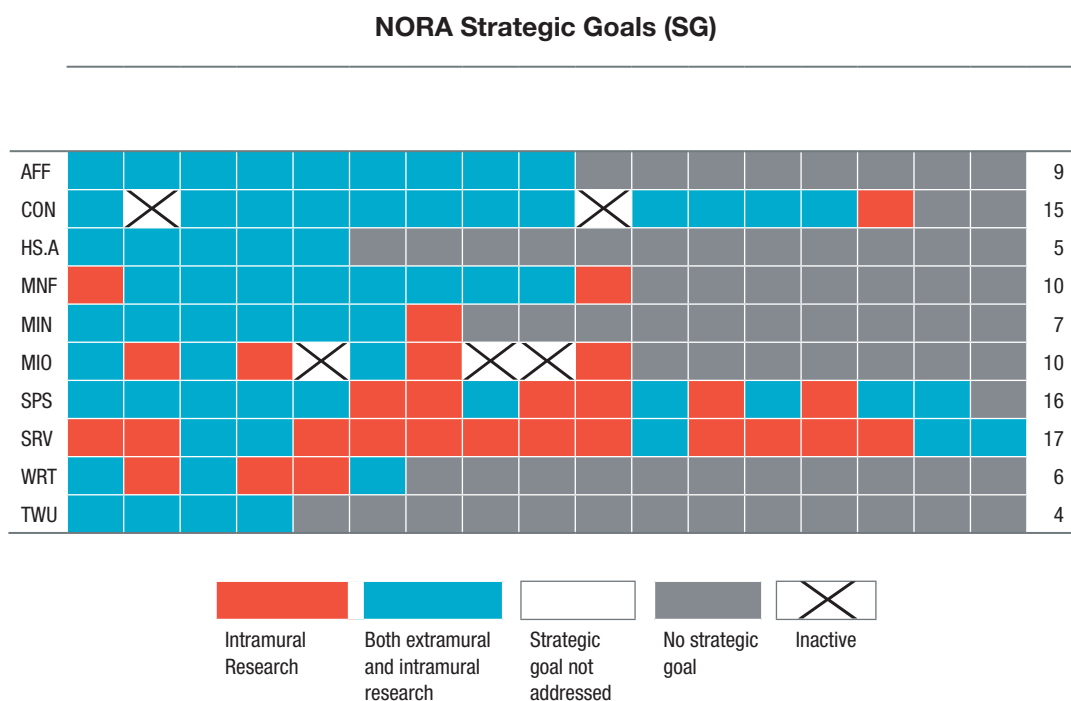


Figure 9. Integration of research goals by sector, FY2013

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V. Appendices

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APPENDIX 1: PEER REVIEW MEETINGS, FY2013

Meeting	Location	Review date	Number of applications reviewed
SOH	Alexandria, VA	October 16–17, 2012	47
SOH-Member Conflict	Phone Review	October 30, 2012	6
TPG SEP	Atlanta, GA	November 8, 2012	6
SOH	Alexandria, VA	February 20–21, 2013	52
NORA	Alexandria, VA	February 21–22, 2013	20
ERC SEP	Atlanta, GA	February 26–March 1, 2013	19
WTC Research	Atlanta, GA	March 5, 2013	10
SOH	Alexandria, VA	June 13–14, 2013	45
SOH-Member Conflict	Phone review	June 20, 2013	2
Hurricane Sandy SEP	Phone review	August 8, 2013	8

SOH = Study Section in Occupational Health, TPG = Training Program Grants, SEP = Special Emphasis Panel, NORA = National Occupational Research Agenda, ERC = Education and Research Center, WTC = World Trade Center

Note: World Trade Center Health Program reviews administered by the Office of Extramural Programs are not included in this report.

APPENDIX 2: NIOSH GRANT MECHANISM ACTIVITY CODES

NIOSH activity codes	Grants and agreements
K01	Research Scientist Career Development Grant
R01	Research Project Grant
R03	Small Research Grant
R13	Conference Grant
R21	Exploratory/Developmental Grant
R43/R44	Small Business Innovation Research
T03	Training Project Grant
T42	Education and Research Center Grant
U01	Research Cooperative Agreement
U54/U60	Other Cooperative Agreement

APPENDIX 3: NIOSH PROGRAM ANNOUNCEMENTS BY MECHANISM

Announcement no.	Mechanism	Title
PAR-13-245	K01	Mentored Research Scientist Development Award
RFA-OH-13-001	U60	National Center for Construction Safety and Health Research and Translation
RFA-OH-13-002	U01	NIOSH Cooperative Agreement Research to Aid Recovery from Hurricane Sandy
PAR-13-129	R01	Occupational Safety and Health Research
PAR-12-200	R03	NIOSH Small Research Program
PAR-10-272	R13	NIOSH Support for Conferences and Scientific Meetings
PAR-12-252	R21	NIOSH Exploratory/Developmental Grant Program
PA-13-234†	R43, R44	Reissue PHS 2013-02 Omnibus Solicitation of the NIH, CDC, FDA and ACF for Small Business Innovation Research Grant Applications
PAR-10-288	T03	Occupational Safety and Health Training Project Grants
PAR-10-217	T42	Occupational Safety and Health Education and Research Centers
PAR-11-022	U54	Centers for Agricultural Disease and Injury Research, Education, and Prevention
RFA-OH-14-002	E11	Cooperative Agreement on Occupational Health with the World Health Organization
PAR-12-126	U01	Cooperative Research Agreements Related to the World Trade Center Health Program

†Issued by the National Institutes of Health

APPENDIX 4: FY2013 EXTRAMURAL RESEARCH OUTPUTS

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 (Ag 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.

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. While 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.

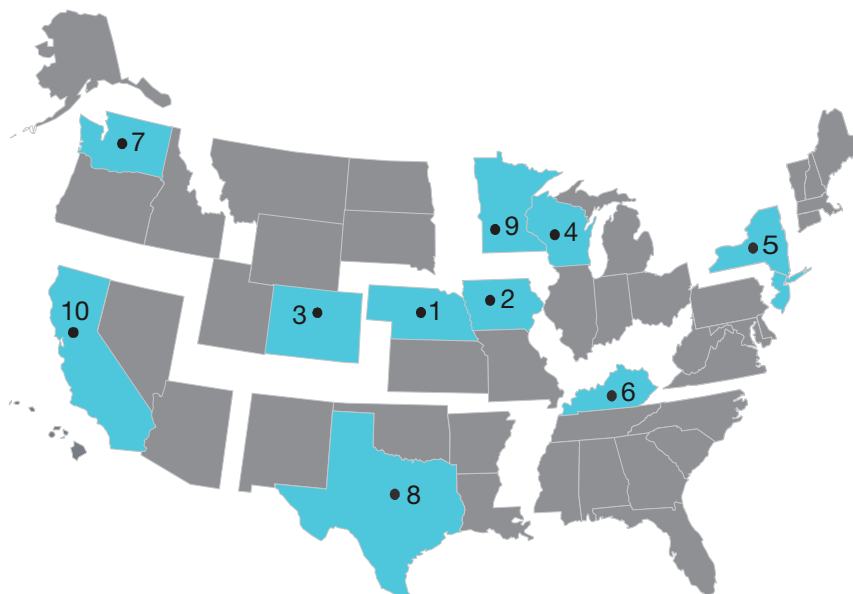
The Centers' work spans the full research-to-practice continuum. They conduct basic science to evaluate and quantify a problem as well as translating these results into engineering controls, educational outreach efforts, or policy changes aimed at preventing or mitigating the problem. While the Centers' 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.

c. Public health Impacts

- 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 numerous 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

The 10 NIOSH Ag Centers funded in FY2013 are shown in the map below:

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

d. Extramural Funding for Ag Center Grants in FY2013

Nine Ag Centers and one National Children's Ag Center were funded in FY2013. These centers were funded using ongoing funds and no new awards were made (see table below.)

Ag center institution	PI last name	Start Date	End Date
Colorado State University	Reynolds	9/15/2011	9/14/2016
Marshfield Clinic	Lee	9/30/2008	9/29/2013
Mary Imogene Bassett Hospital	May	9/30/2011	8/31/2016
University of California at Davis	Schenker	9/30/2011	9/29/2016
University of Iowa	Gerr	9/30/2011	9/29/2016
University of Kentucky Research Foundation	McKnight	9/30/2011	9/29/2016
University of Minnesota	Alexander	9/30/2011	9/29/2016
University of Nebraska Medical Center	Rautianen	9/01/2011	8/31/2016
University of Texas Health Center at Tyler	Levin	9/30/2011	9/29/2016
University of Washington	Fenske	9/30/2011	9/29/2016

e. Outputs

Peer-reviewed publications and impact factor

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, and PubMed database. From October 1, 2012, to September 30, 2013, there were 47 publications from Ag Centers (Activity Codes = U50 and U54). The journal most frequently published in was the *Journal of Agromedicine* with 8 publications in FY2013. A searchable database of NIOSH publications can be found at on the [OEP webpage Grantee Award Final Reports and Publications](#).

Across the 47 publications, the average impact factor rating was 3.158 with the range extending from 1.973 for the *American Journal of Industrial Medicine* to 30.026 for the *Journal of American Medical Association*.

f. Selected Stories of Impact

Geographic diversity in production areas drives the need for a regional approach

The Centers' regional focus and identification with specific scientific themes acknowledge the inherent differences in food production practices throughout the country and the need to tailor technical expertise, research topics, and outreach programs to the appropriate issues and affected populations. Variation in work practices, even for similar consumer products, generates unique hazards. The Ag Centers' regional focus enables them to be responsive to the relevant agricultural health and safety issues in their area, thus fitting research, education, and outreach projects to the appropriate workforce characteristics.

Take for example the apple, a crop found in most states and with a total annual market value approaching \$3 billion. The United States is the second-leading producer of apples in the world. However, all apples are not created equally. While consumers purchase this tree fruit industry commodity by the bushel at their local markets, apple production is distinctly different in various parts of the country. Pruning and trellising techniques used in the Pacific Northwest create a distinctly different form of tree when contrasted against unaltered growth patterns that result in a more natural shape. This in turn creates different hazards and health risks for workers during what otherwise would seem like the same tasks of tree care and fruit harvesting. Musculoskeletal disorders in the Northeast and South where ladders predominate are unlike the disorders found in the Pacific Northwest where workers rely on elevated, mobile platforms for harvesting. Pesticide exposure risks are also very different in these regions due to application equipment and methods. As these examples illustrate, a one-size-fits-all approach to evaluating and reducing musculoskeletal disorders and pesticide exposure risks doesn't work for this commodity production cycle.

The apple case study is not unique. Similar concerns have been identified in other commodity areas where work practices, environmental conditions such as extreme cold or heat, or a combination of these variables drive the need for a more locally relevant approach. Swine barn work during the winter months in the Midwest presents very different risks compared to similar tasks in other more temperate regions of the country. Extreme cold conditions force a reliance on indoor-related activities, and significantly less outside air circulation results from attempting to constrain energy costs. These factors lead to elevated air concentrations for many known pollutants, along with increased exposure durations. Similarly, tractor hazards vary across the country due to differences in equipment age, terrain, and ingrained work habits. Geographically unique production models require more specific occupational safety and health advances, irrespective of the commodity under production.

The human-machine interface continues to present serious hazards

Equipment use in agriculture, fishing, and forestry activities continues to present significant hazards. Injuries associated with machine or assistive equipment use often have a higher human and societal cost than the average occupational injury. Regardless of the scenario—farmers and tractors, loggers and timber harvesting equipment, fisherman and winches—equipment use and misuse leads to avoidable injury and death in the workforce. All of the Ag Centers have ongoing projects working on different aspects of the problem, according to the need or circumstances most often encountered in their region.

Tractor overturns are the leading cause of agricultural deaths in the United States, averaging over 100 deaths annually. NIOSH estimates that more than 70% of these deaths can be prevented if a combination of rollover protection structures and seatbelts is in use. Efforts to get farmers to install rollover protection structures and power take-off shielding have resulted in hundreds of saved lives and limbs. However, change has come slowly in this area as the message is often met with economic obstacles. The Ag Centers are taking different approaches to instigate change, including partnering with manufacturers and trade organizations to decrease costs while increasing availability of these lifesaving features.

Research to practice on organic dust toxic syndrome spans many animal husbandry and crop activities

Multiple Centers are working to improve our understanding of organic dust toxic syndrome (ODTS), a flu-like illness and a prevalent health concern for those involved with animal husbandry or crop activities. Epidemiological studies have found substantial changes in pulmonary function and increased respiratory symptoms in 20% to 30% of farmers working with grain and in enclosed livestock facilities. Centers have collaborative projects that seek to explain the basic biology of this condition as well as increase our knowledge regarding different exposure sources, routes, and contributing factors. Centers are also providing groundbreaking research on sampling and analysis methods for these dust mixtures. Ultimately, this work is leading to the creation of prevention strategies and educational outreach programs that help workers cope with this ubiquitous agriculture hazard.

Coordinated communication, education, and outreach activities across all Ag Centers

Much of what the Ag Centers do from a scientific perspective would have very little impact within the workforce if not for the use and promotion of this information in educational, prevention, and outreach activities, all required components within each Center. Message penetration is a common refrain among the Centers as they try to promote known solutions to specific problems or hazards through the use of social media, traditional information dissemination routes such as mailings and flyers, and in-person interactions and trainings at trade shows or other farm events. Multiple Centers are investigating and addressing similar concerns in different parts of the country (e.g. musculoskeletal disorders, heat-related illness, bioaerosol exposures) and coordinating/communicating their working to solve these problems.

A recent joint effort by the Centers was the creation of a YouTube channel dedicated to U.S. Agriculture Safety and Health topics (<https://www.youtube.com/user/USagCenters>). This collaboration, launched in late 2013, provides safety and health videos on dozens of topics. The video collection has been met with an enthusiastic response from the community based on the hundreds of subscribers and tens of thousands of views to date.

Embracing technology and innovation to solve long-standing problems

Technological advancement is important to American agriculture, forestry, and fishing, and it continues to transform work practices. In some cases, technology has helped to eliminate a known hazard while in other scenarios it has helped to design-out potential hazards via control technologies. Some examples include:

- Smartphone tractor rollover notification app uses the gyroscope to detect a rollover event, SMS to notify emergency services, and the GPS to help locate the victim—all functions contained within many smart phones now on the market.
- Manure ventilation app for confined space entry risks, being developed by Penn State via North East Center
- Tractor stabilizer initiative

2. National Center for Construction Research and Training

a. Overview

The CPWR—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 (<http://www.cpwr.com/research/current-research-projects>).

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 FY2013, 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. Public Health Impact

CPWR accomplishments and outcomes address a variety of topics and issues in construction safety and health. Depending upon the topic/issue, the targeted resource is for workers, union and non-union labor, contractors, associations, or project owners. Accomplishments include:

- Conducted 15 multiyear research projects, including ergonomics, noise, respiratory disease and welding hazards, surveillance, and work organization and other contributing factors. Many peer-reviewed and other types of publications were attained.
- Planned and hosted two national workshops and 4 webinars.
- Reorganized its Construction Economics Research Network as a separate entity known as the Institute for Construction Economics Research, the first organization to be created out of one of our National Construction Center networks as its own not-for-profit with direct industry governance and funding.
- CPWR published the fifth edition of the Construction Chart Book: The U.S. Construction Industry and its Workers (<http://www.cpwr.com/publications/construction-chart-book>). The chart book is used by safety trainers, safety management programs, researchers, agencies, and advocacy groups.

- Published 52 new tool box talks.
- Managed 11 new research projects through the CPWR Small Studies Program.
- Produced 3 short training videos, each based on the true story of a fatal construction incident.
- Expanded content in the national repository for safety and health information (www.elcosh.org).
- Expanded content for hazards and engineering control solutions for two national repositories (www.cpwrconstructionsolutions.org, www.silica-safe.org).
- Actively partnered with NIOSH and OSHA in a national construction falls fatalities prevention campaign (www.stopconstructionfalls.com).

d. Funding

Institute	PI last name	Start date	End date
Center for Construction Research and Training	Stafford	09/01/2009	08/31/2014

e. Outputs

Peer-reviewed publications and impact factor

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, and PubMed database. From October 1, 2012, to September 30, 2013, there were 16 publications from the National Center for Construction Research and Training (Activity Codes = U54 and U60). The journal most frequently published in was the *Journal of Occupational and Environmental Hygiene* with three publications in FY2013. A searchable database of NIOSH publications can be found at Grantee Award Final Reports and Publications on the OEP webpages.

Across the 16 publications, the average impact factor rating was 1.857 with the range extending from 1.278 for the *Journal of Occupational and Environmental Hygiene* to 3.775 for the journal *Scandinavian Journal of Work, Environment, and Health*.

f. Selected Stories of Impact

Research dissemination road mapping guide

CPWR—Center for Construction Research and Training completed and refined a “Research Dissemination Roadmap” to guide CPWR investigators and research consortium partners as they plan how to promote the use of their research findings. Researchers are urged to consider—among other things—their “cargo” (the intervention or findings to be delivered), their “point of departure” (dissemination steps already taken), “local guides” (knowledgeable local partners who can help in the research-to-practice effort), and the best “vehicles” for the journey (dissemination strategies that will be the most effective). The road mapping guide is also available to any investigators interested in using it and can be found on CPWR’s website at www.cpwr.com.

Putting data to action and practice: Construction Chart Book 5th Edition

While the focus has been on collaboration with industry partners to get research findings into the hands of construction stakeholders, in 2013 CPWR also published the fifth edition of the *Construction Chart Book: The U.S. Construction Industry and its Workers*. The new edition features more charts and topics not covered in previous editions, such as green construction, employment projects, unemployment and re-employment rates, and risks of falls, MSDs, respiratory hazards, and hearing loss by trades (www.cpwr.com). The data also serves to inform and support new research along with policy and practice recommendations for the protection of construction workers in the United States.

In 2013, CPWR partnered with McGraw-Hill Construction, publisher of *Engineering News Record*, to survey hundreds of construction contractors to learn about their safety management practices. Respondents were drawn from McGraw-Hill's contractor research panel. Ninety-two percent of firms surveyed with over 500 employees reported having fully inclusive and widely observed safety programs, but smaller firms lagged with nearly half, 48%, reporting inclusive and widely observed safety programs. However, individual safety practices are widely adopted across the industry, demonstrating an awareness of the importance of safety programs; 60% of contractors report that they use 8 of 15 practices included in the survey. The most widely used practices demonstrate the value construction firms place on bringing safety practices directly to jobsites. CPWR worked with McGraw-Hill on a press release, which went to all major media outlets and was picked up by *The Wall Street Journal*.

Library of new Toolbox Talks and videos

In collaboration with NIOSH, which developed initial content, CPWR produced 52 new toolbox talks on common construction hazards in 2013. The talks have been designed to be printed for use on construction sites and in the class room. All are available for free download on CPWR's website (www.cpwr.com). In 2013, CPWR used information collected by NIOSH to create three short training videos, each based on the true story of a fatal construction incident. The videos are posted on the new CPWR YouTube channel. Each posting has text with links to the appropriate Toolbox Talk, handout, and the original NIOSH FACE Report, making for a complete training package.

New guide to aid in tech transfer

CPWR organized and hosted a Tech Transfer symposium, bringing researchers together with government, manufacturing, contractor associations, labor, and insurance industry representatives to discuss barriers and strategic approaches to diffuse health and safety technologies and best practices across the construction industry. Workshop participants identified the need for a basic guide for construction safety and health investigators on the steps and options in moving proven interventions to market in the U.S. construction industry. In 2013, CPWR CCRT developed the *Intellectual Property Patent and Licensing Guide for Construction Safety and Health*. A dissemination plan for the new guide is in the development phase. The guide is available on CPWR's website (www.cpwr.com).

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 worker health promotion interventions. 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 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 adoption of comprehensive, coordinated work-based health protection and promotion interventions; investigating costs and benefits associated with integrated programs; and 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

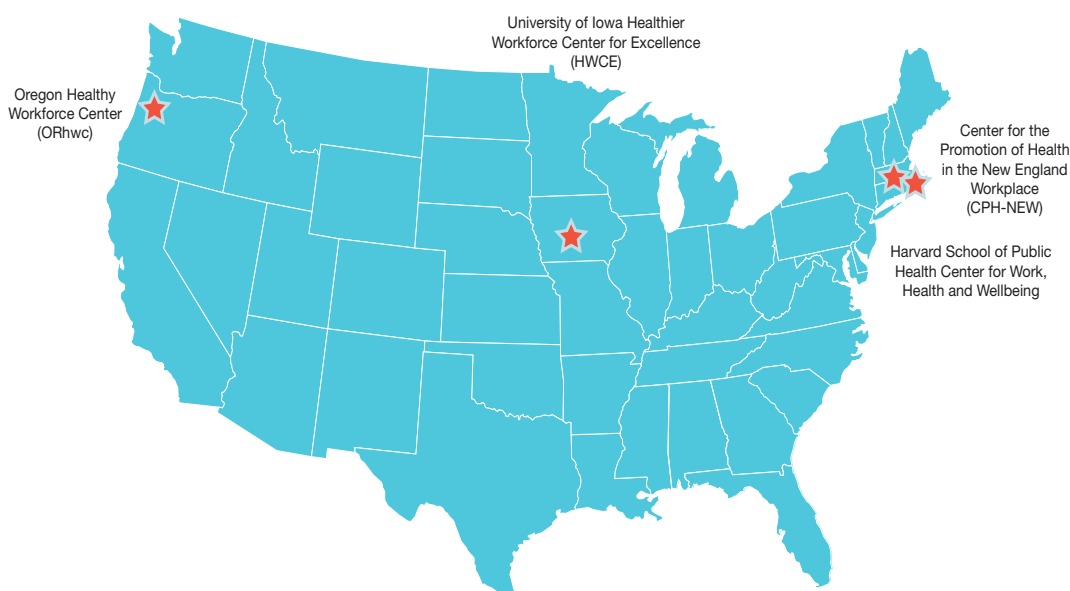
The Centers of Excellence develop and evaluate interventions that have improved safety, health, wellness and well-being—TWH—in high-risk industries that can reduce healthcare costs when adopted on a broad scale. The Centers facilitate translation from research to practice, testing the process and feasibility 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. Public Health Impact

- 196 organizations have received some webinar training on the CPH-NEW Research-to-Practice Toolkit for establishing their own Healthy Workplace Participatory Programs.
- Findings on safe patient handling have been recognized by the Institute of Medicine, Massachusetts Department of Public Health, and Veterans Health Administration.
- Home Care Worker Total Worker Health intervention adopted by Oregon Home Care Commission for roll out in their training programs in four cities.
- Oregon and the Workplace blog designed to inform occupational health and safety practitioners, viewed over 3,000 times (hits) per month.
- Results from the Real Iowan's Research Initiative provide baseline measures and employment-sector estimates of health status, prevention behaviors, and productivity measures by employment status for the state of Iowa.

- Findings were published in the Journal of Occupational and Environmental Medicine in July 2014, titled “Employment Status Matters—A Statewide Survey of Quality-of-Life, Prevention Behaviors, and Absenteeism and Presenteeism.”
- The JOEM Total Worker Health Supplement is considered foundational for expanding the scientific rationale for advancing the field of Total Worker Health.

Centers of Excellence to Promote a Healthier Workforce



d. NIOSH Funded Centers of Excellence in FY2013

Institution	PI last name	Start date	End date
Harvard University	Sorensen	9/01/2007	8/31/2016
Oregon Health and Science University	Anger	9/01/2011	8/31/2014
University of Iowa	Merchant	9/01/2006	8/31/2016
University of Massachusetts Lowell	Punnett	7/01/2006	7/31/2016

e. Outputs

Peer-reviewed publications and impact factor

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, and PubMed database. From October

1, 2012, to September 30, 2013, there were nine publications from the Centers of Excellence to Promote a Healthier Workforce (Activity Code = U19). The journals most frequently published in were the *American Journal of Industrial Medicine* and *Workplace, Health, and Safety*, both with two publications in FY2013. A searchable database of NIOSH publications can be found at Grantee Award Final Reports and Publications on the OEP webpages.

Across the nine publications, the average impact factor rating was 1.462 with the range extending from 0.509 for the journal *Workplace Health and Safety* to 1.973 for the *American Journal of Industrial Medicine*.

f. Selected stories of Impact

CPH-NEW has initiated a mentoring program for correctional workers

CPH-NEW projects identified key work-related factors and personal high-risk behaviors in two occupations recognized as hazardous: nursing home personnel and corrections employees. The effectiveness of workplace interventions have been examined in both settings. The Center features an integrative and comprehensive approach to reducing workplace hazards and promoting worker health by identifying the links between workplace culture and personal high-risk behaviors and the issues that transcend the workplace, such as work-family strain. CPH-NEW also conducts expanded economic analyses that include healthcare utilization and cost barriers to program implementation; a multidimensional productivity/business case approach to prioritizing workplace changes has also been developed. Surveys and other research methods have been adapted to meet practitioner's needs.

Tool for indexing programs on a continuum of integration

The Harvard Center for Work, Health, and Wellbeing's high-impact outcomes include very successful executive and continuing professional education courses held annually. The course attracted 40 professionals to learn about integrated approaches for TWH. Participants came from 17 states and from 6 countries across 4 continents. In addition, the dissemination impact of this course includes developing new U.S. and global partnerships with governmental, social service, and industrial sectors to collaborate on advancing and disseminating integrated approaches for TWH. In addition, the Center implemented Be Well, Work Well project on select patient care units with initial adoption of the program by a major hospital in the Boston area. The program includes targeted, multiple levels of the unit organization with a one-on-one, hands-on safe patient handling training program, organizational and ergonomics assessments, and health leadership coaching.

Home care worker intervention adopted by Oregon Home Care Commission in four cities

Home care workers have an injury rate that is nearly four times higher than the U.S. average and are at an elevated risk for mental and physical health problems. Many home care workers are self-employed or employed by their client and lack typical organizational support structures. The Oregon Center of Excellence organized workers into neighborhood-based teams, which met regularly for scripted education sessions and social support. Average attendance

was 81%; mean favorability rating was 4.2 on a 5-point scale and 63% of participants reported making behavior changes between meetings. Six months after the program ended, these home care workers reduced sugary drinks, had increased good cholesterol, increased tool use for patient transfer, and reduced lifting; the results were statistically reliable.

Employment Status Matters

To address the need for baseline, evidence-based data on the statewide workforce, the University of Iowa Healthier Workforce Center for Excellence (HWCE) developed the Real Iowan Research Initiative. In 2010, the HWCE conducted a survey of 1,271 Iowans to provide statewide employment sector estimates of health status, prevention behaviors, and productivity measures by employment status (self-employed, employed by an organization, or currently unemployed but seeking employment). Importantly, it also assessed whether quality-of-life and prevention behaviors were linked with sickness absenteeism and presenteeism (self-rated job performance during the last 4 weeks). Results showed that higher quality-of-life measures and having more prevention behaviors are strongly associated with lower absenteeism and higher presenteeism scores. Findings were published in the *Journal of Occupational and Environmental Medicine* in July 2014, titled “Employment Status Matters—A Statewide Survey of Quality-of-Life, Prevention Behaviors, and Absenteeism and Presenteeism.” Results from the Real Iowan’s Research Initiative provide baseline measures and employment sector estimates of health status, prevention behaviors, and productivity measures by employment status for the state of Iowa.

JOEM Total Worker Health Supplement

The Healthier Workforce Center for Excellence (HWCE) at the University of Iowa coordinated the publication of a *Total Worker Health Supplement* in the *Journal of Occupational and Environmental Medicine* (JOEM) in November 2013. Manuscript content was based on presentations from the 2012 Total Worker Health™ Symposium, also coordinated by the HWCE. The supplement is publicly available by open access and includes opening comments from NIOSH Director Dr. John Howard, a commentary with expert’s views on TWH, seven reviews, four research articles, and three research-to-practice articles. The supplement is considered foundational for expanding the scientific rationale for advancing the field of TWH and can be accessed at <http://journals.lww.com/joem/toc/2013/12001> or www.hwce.org.

4. Education and Research Centers

a. Overview

NIOSH supports professional training in occupational safety and health (OSH) in a variety of disciplines 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 OSH. ERCs also provide continuing education and outreach to the OSH community throughout the federal health region they serve. The ERCs are interdisciplinary programs that address OSH training and research training in a cross-cutting and integrated

manner. The ERCs are the major part of a network of training grants that help ensure an adequate supply of qualified professional OSH practitioners and researchers.

An essential component of ERCs is outreach and research-to-practice activities with other institutions, businesses, community groups, or agencies located within their region. Programs are encouraged to address area needs and implement innovative strategies for meeting those needs with a focus on impacting worker health and safety.

b. Public Health Relevance

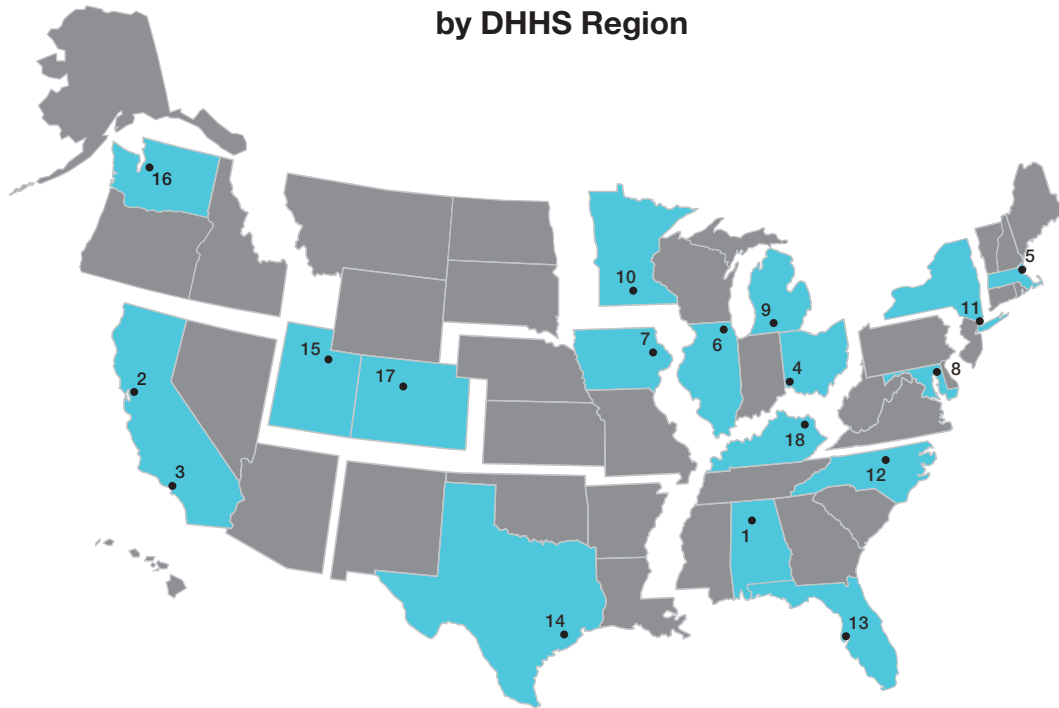
As mandated in the Occupational Safety and Health Act (PL-596, Sec. 2), NIOSH “shall conduct ... education programs to provide an adequate supply of qualified personnel to carry out the purposes of this Act ...” NIOSH responds to this mandate by funding training programs in the core and allied disciplines of OSH to increase the number and competencies of the OSH workforce in the United States. NIOSH-funded Education and Research Centers (ERCs) are central to this mandate and serve a vital role in protecting and promoting the health and safety of our nation’s workforce. In alignment with the goals of Healthy People 2020, to prevent diseases, injuries, and deaths that are due to working conditions, ERCs improve OSH through education, research, and collaboration. 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. ERCs are the regional and national resource on OSH issues for business, labor, government, and the public. During the FY13 academic year, the ERCs enrolled a total of 864 trainees in OSH academic programs; 541 (63%) were NIOSH-supported, and a total of 190 ERC trainees were graduated to enter the OSH workforce.

c. Public Health Impact

- Provide the U.S. workforce with the OSH expertise needed to reduce the burden of occupational injury, illness, and death.
- Develop the major research innovations needed to prevent occupational injuries and diseases in the United States.
- Provide 450,000 person-hours of professional development training for practicing safety and health professionals in 10,000 businesses.
- Provide regional and industry-specific outreach and consultation to over 5,000 small, medium, and large-sized U.S. businesses annually.
- Serve as the primary source of accessible experts to the public and government leaders for OSH issues and do not duplicate any other U.S. government program.

A total of 18 ERCs were funded in FY2013 and are represented in the map below:

NIOSH Education and Research Centers by DHHS Region



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

Training disciplines in the 18 ERCs supported in FY2013 are shown below:

ERC Institution	CE	Pilot Project	IH	OHN	OM	Safety	TRT	Injury Prev	Occ Epi	Ergo-nomics	Bio-markers	Occ Psych	Ag OSH	Occ Physics	Occ Health Services	Mining
Harvard University	x	x	x	x	x	x		x	x							
Johns Hopkins University	x	x	x	x	x	x		x			x					
Mt. Sinai School of Medicine	x	x	x	x	x	x				x						
Southern California (UCLA and UC)	x	x	x	x	x	x	x									
University of Alabama at Birmingham	x	x	x	x	x	x		x								
University of California at Berkeley	x	x	x	x	x	x	x			x						
University of Cincinnati	x	x	x	x	x	x	x				x					
University of Colorado	x	x	x	x	x	x				x				x		
University of Illinois at Chicago	x	x	x	x	x	x	x		x				x			
University of Iowa	x	x	x	x	x	x	x		x				x			
University of Kentucky	x	x	x	x	x	x										x
University of Michigan	x	x	x	x	x	x	x		x							
University of Minnesota	x	x	x	x	x	x		x	x						x	
University of North Carolina	x	x	x	x	x	x	x		x		x					
University of S. Florida	x	x	x	x	x	x						x				
University of Texas	x	x	x	x	x	x		x	x							
University of Utah	x	x	x	x	x	x	x		x							
University of Washington	x	x	x	x	x	x	x		x						x	
Subtotal	18	16	16	12	15	10	7	9	8	4	3	2	3	1	2	1

CE = Continuing Education; IH = Industrial Hygiene; OHN = Occupational Health Nursing; OM = Occupational Medicine; TRT = Targeted Research Training; Injury Prev = Injury Prevention; Occ Epi = Occupational Epidemiology; Occ Psych = Occupational Psychology; Ag OSH = Agriculture Occupational Safety and Health; Occ Physics = Occupational Physics; Occ Health Services = Occupational Health Services

d. Funding

In FY2013, a total of 18 ERCs received NIOSH funding with appropriated funds of \$23,005,303 to the following institutes:

ERC Institution	PI last name	Start date	End date
Harvard School of Public Health	Christiani	7/01/2013	6/30/2018
John Hopkins University	Agnew	7/01/2013	6/30/2018
Mount Sinai School of Medicine	Lucchini	7/01/2011	6/30/2016
University of Alabama-Birmingham	Lungu	7/01/2012	6/30/2017
University of California Berkeley School of Public Health	Balmes	7/01/2010	6/30/2015
University of California-Los Angeles	Krause	7/01/2012	6/30/2017
University of Cincinnati	Reponen	7/01/2011	6/30/2016
University of Colorado Health Sciences Center	Newman	7/01/2010	6/30/2015
University of Illinois	Conroy	7/01/2008	6/30/2014
University of Iowa	O'Shaughnessy	7/01/2008	6/30/2014
University of Kentucky	Sanderson	7/01/2012	6/30/2014
University of Michigan	Batterman	7/01/2013	6/30/2018
University of Minnesota	Gerberich	7/01/2010	6/30/2015
University of North Carolina-Chapel Hill	Rogers	7/01/2012	6/30/2017
University of South Florida	Bernard	7/01/2011	6/30/2014
University of Texas Health Science Center Houston	Symanski	7/01/2011	6/30/2014
University of Utah	Hegmann	7/01/2013	6/30/2018
University of Washington	Kalman	7/01/2010	6/30/2015

e. Outputs

Trainees, graduates, and employment of graduates

In academic year 2012–2013, 190 students graduated from ERC programs with specialized training in disciplines that include industrial hygiene, occupational health nursing, occupational medicine, occupational safety, and other closely related occupational safety and health fields of study.

Of the 190 ERC graduates in 2012–2013, 158 (84%) entered careers in occupational safety and health or entered more advanced degree programs in OSH. The following table illustrates employment of ERC graduates in the field of occupational safety and health, 2012–2013.

Program	Enrolled	Graduates	Employed or seeking advanced training*
Industrial Hygiene	255	70	62 (89%)
Occupational Health Nursing	152	26	20 (77%)
Occupational Medicine	74	22	15 (68%)
Occupational Safety	97	19	12 (63%)
Other	286	53	49 (92%)
Total	864	190	158 (84%)

ERC graduates work in a variety of OSH-related industries. The placement of FY2013 graduates is shown in the table below by discipline and work setting. Graduates who have gone on to advanced degree training in OSH and graduates currently seeking employment in the OSH field are considered as remaining in the OSH field.

Discipline/industry	Work setting					Total (N = 190)
	Industrial hygiene (N = 70)	Occupational health nursing (N = 26)	Occupational medicine (N = 22)	Occupational safety (N = 19)	Other (N = 53)	
Private Industry	24	3	0	9	11	47
Federal Government	10	1	1	0	7	19
State/Local Govt.	2	2	0	0	5	9
Academic Institutions	10	2	1	2	16	31
Clinics/Hospitals	4	7	9	1	1	22
Advanced OSH Degree	2	2	3	0	2	9
Seeking OSH Placement	10	3	1	0	7	21
Total in OSH	62	20	15	12	49	158
Percentage in OSH	89%	77%	68%	63%	92%	84%

Continuing education outputs

A required component of ERCs is continuing education of OSH professionals. Each year, the NIOSH ERCs provide training to thousands of OSH professionals around the United States through course offerings in the OSH core and related disciplines. The table below summarizes the continuing education activity for FY2013 OSH by discipline.

Discipline	Courses	Trainees	Person hours
Industrial Hygiene	196	5,322	64,212
Occupational Health Nursing	215	7,596	59,705
Occupational Medicine	231	8,495	54,578
Occupational Safety	861	22,290	174,861
Other	291	11,582	99,217
Total	1,794	55,285	452,580

Peer-reviewed publications and impact factor

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, and PubMed database. From October 1, 2012, to September 30, 2013, there were 71 publications across all 18 of the Education and Research Centers (Activity Code = T42). The journal most frequently published in was the American Journal of Industrial Medicine, with eight publications in FY2013. A searchable database of NIOSH publications can be found at Grantee Award Final Reports and Publications on the OEP webpages.

Across the 71 publications, the average impact factor rating was 2.497 with the range extending from 7.260 for the journal *Environmental Health Perspective* to 0.340 for the *Toxicology Pathology* journal.

f. Selected stories of Impact

Safe work practices in disaster response

Following Hurricane Sandy, NY/NJ ERC provided training for residents, volunteers, responders, field inspectors (local and state), and business owners on safe work practices during cleanup to minimize injury and illness. The training covered protection of workers and volunteers from mold and other physical hazards. Occupational medicine residents staffed clinics to assist with the health and exposure assessments of individuals impacted by Hurricane Sandy. The NY/NJ ERC also coordinated the collection and distribution of personal protective equipment, conducted mold awareness training for local communities, and conducted exposure assessments.

The ERC at the University of South Florida was immediately available to assist the Deepwater Horizon Response Team in developing a heat stress program. Dr. Tom Bernard and ERC trainees worked with the Unified Area Command at regional response headquarters in Mobile, Alabama, and Homa, Louisiana, to prevent heat-related disorders. One ERC trainee's research used weather data to establish heat stress levels experienced by cleanup workers. An association was found between heat stress level and heat-related disorders, and between heat stress level and acute injuries.

Reaching workers with greatest needs: vulnerable and at-risk worker populations

Healthcare workers: The Ebola outbreak is a grim reminder of the public health significance of personal protective equipment. North Carolina ERC Center Director, Dr. Bonnie Rogers, was funded by NIOSH to develop, implement, and evaluate an education and practice intervention that incorporates both knowledge and practice components for respiratory protection for healthcare workers. An educational program for healthcare workers and management was developed that incorporated core elements related to respiratory protection for prevention of the transmission of influenza.

Emerging issues

The Cincinnati ERC's residents and faculty have been identifying potentially hazardous occupational exposures associated with the high-volume hydraulic fracturing process (also known as fracking) used to extract natural gas in their region. Their efforts have included disseminating information to workers and to the surrounding communities. Potentially hazardous exposures (chemical, particulate, and noise) as well as safety issues are associated with this process.

Collaboration, leverage and resources

All ERCs have a collaborative spirit to leverage and enhance support from NIOSH. An example is state-level testimony provided by Johns Hopkins ERC faculty and residents at the request

of the International Association of Firefighters. Many states have adopted presumptive cancer legislation regulations to ensure workers' compensation benefits for firefighters who develop cancer from work-related exposures.

Selected impacts of ERC graduates

ERC graduates continue to impact worker health and safety. Examples include Sudha Pandalai, MD, PhD, who co-authored a paper that was nominated for the CDC 2012 Charles C. Shepard Science Award, the preeminent honor recognizing excellence in science at CDC/ATSDR. The paper, "Interaction of occupational and personal risk factors in workforce health and safety" (*Am J Pub Health*, 2012; Schulte PA, Pandalai SP, Wulsin V, Chun HK), discussed issues related to the interrelationships of occupational risk factors (ORFs) and personal risk factors (PRFs) and their combined impacts on disease, illness, and injury. The study's review of the scientific literature demonstrated an extensive catalogue of risk factor interactions, and examples highlighted specific issues for considering combined ORF-PRF contributions to occupational illness and injury.

U.S. troops in Iraq and Afghanistan survive with more severe wounds than those from previous wars because of advances in body armor, field hospitals, and evacuation flights. However, these successes yield a growing population of severely wounded veterans who will need a lifetime of care. University of Washington ERC graduate, Dr. Stephen Hunt is the national director of the Department of Veterans Affairs Post-Deployment Integrated Care Initiative, VA Puget Sound Health Care Systems. Dr. Hunt directs a multidisciplinary post-combat assessment and follow-up clinic for returning veterans in the Puget Sound area. He also co-chairs the national Technical Assistance Team, providing leadership for a national Department of Veterans Affairs initiative for establishing similar integrated post-combat care clinics nationwide. He applies the principles of occupational and environmental medicine and preventive healthcare daily in his clinical care of veterans who have suffered the traumas of war and combat. These principles also guide his development of programs for comprehensive post-combat services.

University of South Florida ERC graduate, Kristin Saboe, a captain in the U.S. Army, is assigned to the Walter Reed Army Institute of Research where she studies PTSD and suicide, a significant public health issue facing those who have served our country. Captain Saboe also served in Afghanistan conducting research on stress among active duty soldiers.

ERCs respond to national assessment of the occupational safety and health workforce

This national survey conducted in 2011 reveals that employers anticipated hiring approximately 25,000 OSH practitioners in the next 5 years, while OSH academic programs (NIOSH and non-NIOSH funded) expected to graduate less than 13,000 students during the same period. ERCs have developed collaborations and innovative approaches to increasing the awareness and building career pipelines to meet the demand for OSH professionals. An example is the Colorado ERC 3-week program for undergraduate and high school students to visit worksites (farm, animal handling facility, and mine) and learn more about the opportunities for a career in OSH. Another example is the Sunshine ERC's Institute. This weeklong program has given students a behind-the-scenes look at occupations in a variety of industries and research labs.

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 will have an impact in reducing 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 (OSH) research projects (R01), small OSH research grants (R03), and exploratory OSH 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 OSH 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 period of 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 novel 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 to explore a new scientific area. These studies may involve considerable risk but 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. Public Health Impact

Research grants addressed a variety of topics and issues in occupational safety and health including:

- Developing an understanding of the risks and conditions associated with occupational diseases and injuries,
- Exploring methods for reducing risks and for preventing or minimizing exposure to hazardous conditions in the workplace, and
- Translating significant scientific findings into prevention practices and products that effectively reduced work-related illnesses and injuries.

d. Funding

Funding data for all research grants in FY2013 are provided below. These data are also available on the NIOSH [extramural research portfolio website](#).

Type of grant	New awards	New funding	Continuing awards	Continuing funding	Total funding
R01	16	\$7,687,976	35	\$15,374,494	\$23,062,470
R21	12	\$2,801,872	15	\$2,827,244	\$5,629,116
K01	1	\$107,664	6	\$647,406	\$755,070
R03	3	\$215,075	6	\$447,513	\$792,683
Total	32	\$10,812,587	62	\$19,296,657	\$30,339,339

e. Outputs

Peer-reviewed publications and impact factor

From October 1, 2012, to September 30, 2013, there were 171 publications across all types of investigator-initiated research (Activity Codes = R01, R03, R18, and R21). The journal most frequently published in was the *American Journal of Industrial Medicine*, with 14 publications in FY2013. A searchable database of NIOSH publications can be found at Grantee Award Final Reports and Publications on the OEP webpages.

Across the 171 publications, the average impact factor rating was 3.013 with the range extending from 0.509 for journal *Workplace Health and Safety* to 20.833 for the journal *Accounts of Chemical Research*.

f. Selected Stories of Impact

Carbon Nanotube Biodegradation by Neutrophil Myeloperoxidase

PI: Kagan

University of Pittsburgh R01OH008282-09

Carbonaceous nanomaterials are at the forefront of numerous and diversified nanotechnological applications in many industries and biomedicine mostly due to their unique mechanical, electronic, and optical properties. Specifically, carbon nanotubes (CNTs) have been

implemented in therapeutic and diagnostic/imaging (theranostic applications). In an idealized situation, CNTs would be disposed of after they transport their theranostic payloads. Biodegradation represents an attractive pathway for the elimination of CNT carriers post-delivery and may be integral to catalyzing the release of the cargo from the delivery vehicle. However, a notoriously known bio-persistence and pulmonary toxicity of CNTs have always been perceived as a stumbling block on the way of their broader applications as well as a health hazard/risk associated with their occupational and environmental exposures.

The investigators pioneered the field of research that identified several diversified enzymatic systems involved in the process of CNT biodegradation in different types of cells, particularly inflammatory cells, recruited to the sites of exposure. They have discovered that the major oxidative enzymatic machinery of neutrophils—myeloperoxidase—is a powerful mechanism of CNT biodegradation, defining their fate at the early stages of inflammatory response. Similarly, eosinophil peroxidase determines the features of CNT distribution and clearance in eosinophils. They further established that at later stages of inflammatory response, macrophages are the major types of inflammatory cells responsible for the effective clearance of CNT from the lung. In this case, the proximal oxidant responsible for the oxidative biodegradation is peroxynitrite generated from superoxide and nitric oxide. The latter two types of molecules are produced in macrophages by two enzymatic systems: NADPH oxidase from superoxide and iNOS from nitric oxide.

The seminal work in this area has laid down the fundament for the numerous further studies and publications detailing the involvement of these basic mechanisms in the fate of carbonaceous materials in the lung. The significance of the project's findings for the field of nanotechnology is that “safe-by-design” types of nanoproducts can be developed with enhanced profiles of biodegradations and clearance from the body. Moreover, the process of biodegradation may be utilized for improved and optimized types of targeted delivery of drug payloads encapsulated into nanocontainers and targeted to specific types of cells. Overall, during the period of funding that commenced in 2010, the investigators have published 27 papers in the most prestigious, high-impact journals such as *Nature Nanotechnology*, *ACS Nano*, *Small*, *Accounts of Chemical Research*, *American Journal of Respiratory Cell and Molecular Biology*, *Toxicology*, and *Applied Pharmacology*. Their discoveries have obtained broad publicity as illustrated by the appearance of press releases and commentaries in different nonspecialized journals of general scientific content.

The significance of their discoveries in the field of nanoparticle biodegradations is also emphasized by a patent: Degradation of Nanomaterials; inventors Alexander Star, Valerian E. Kagan, Brett Lee Allen, 2013, US 8530227 B2.

Preventing Exposure to Ticks and Tick-Borne Illness In Outdoor Workers

PI: Meshnick

University of North Carolina R01OH009847

This study involved a 2-year randomized controlled trial of long-lasting permethrin-treated (LLPI) uniforms for protection against tick bites. The study was completed in 2013 and

published in May 2014. Subjects included outdoor workers from the North Carolina State Divisions of Forestry, Parks and Recreation, and Wildlife who worked in eastern or central North Carolina. A total of 159 volunteer subjects were randomized, and 127 subjects completed the first year of follow-ups and 101 subjects completed the second year of follow-ups. Study subjects reported 1,045 work-related tick bites over 5,251 person-weeks of follow-up. The mean number of reported tick bites was markedly reduced in subjects wearing treated uniforms. Protective efficacy was 0.82 (95% CI=0.66, 0.91) for the first of follow-up and 0.34 (95% CI=-0.67, 0.74) for the second year of follow-up. Workers wearing treated clothing also reported reductions in chigger and mosquito bites. These results indicate that long-lasting permethrin impregnated uniforms are highly effective for at least 1 year in deterring bites from potential disease vectors. The study was covered in *The Wall Street Journal* and the *University of North Carolina Press*.

Publications that are credited to this project include:

Vaughn M, Funkhouser SW, Lin F-C, Fine J, Juliano JJ, Apperson CS, Meshnick SR [2014]. Long-lasting permethrin impregnated uniforms: a randomized-controlled trial for tick bite prevention. *Am J Prev Med* 46(5):473–480.

G-Estimation Methods and Applications to Quantitative Exposure

PI: Picciotto

University of California Berkeley

R03OH010202

When workers in poorer health are more likely to decrease their exposure by transferring to unexposed jobs or leaving work entirely, it becomes difficult to detect an association even if exposure causes disease. This project aimed to improve control of this “healthy worker survivor effect” by extending causal methods (hitherto applied only to binary exposures) to cumulative exposures, in order to investigate the health impact of interventions to limit occupational exposures. The method was applied in the UAW-GM autoworkers cohort to study the effects of cumulative exposure to oil-based metalworking fluids on cardiovascular outcomes. To date, they have had a paper accepted for publication in *Occupational and Environmental Medicine*, covering the issues around censoring at employment termination, and another for publication in the *American Journal of Epidemiology*. The latter paper (in press) applies a novel public health framework to an examination of cardiovascular mortality outcomes (including ischemic heart disease, acute myocardial infarction, and cerebrovascular disease) in relation to oil-based metalworking fluids. The approach consists of estimating the number of years of life saved under a series of different hypothetical regulations on exposure levels. Their findings include evidence that as many as 4,003 years of life were lost to ischemic heart disease in this cohort of autoworkers due to exposure to metalworking fluids. Banning these fluids would have saved 2,932 years of life lost to acute myocardial infarction and 917 lost to cerebrovascular disease. However, the benefits of lower limits falling short of a complete ban were noticeably lower, except for cerebrovascular deaths. Another manuscript under preparation is important because it will probably be the first g-estimation analysis in an occupational study to examine the whole history of quantitative exposure rather than its problematic summary measure, cumulative exposure, which conflates duration and intensity

of exposure. Their approach has potentially wide applicability both within occupational epidemiology and for environmental epidemiology more generally. In occupational epidemiology, their ultimate goal is the protection of worker health. By reporting results from their studies in terms that are easily communicated to policymakers and the general public, they may be more successful in promoting more stringent regulations.

Publications that are credited to this project include:

Picciotto S, Brown DM, Chevrier J, Eisen EA [2013]. Healthy worker survivor bias: implications of truncating follow-up at employment termination. *Occup Environ Med* 70:736–742.

Picciotto S, Peters A, Eisen EA [in press]. Hypothetical exposure limits for straight metalworking fluids and cardiovascular mortality in a cohort of autoworkers: structural accelerated failure time models in a public health framework. *Am J Epidemiol*.

Picciotto S, Chevrier J, Balmes J, Eisen EA [2014]. Hypothetical interventions to limit metalworking fluid exposures and their effects on COPD mortality: G-estimation within a public health framework. *Epidemiol* 25:436–443.

Development and Validation of a Novel In Vivo Neutron Activation Analysis Technology

PI: Nie

Purdue University R21OH010044

The project addressed a critical problem regarding the development and validation of a novel technology to assess cumulative exposure to one of the most significant metal neurotoxins—manganese—among workers. The investigators developed a prototype transportable neutron-activation analysis (NAA) system in their lab to quantify manganese (Mn) in human bone in vivo at Purdue University. The system has been tested and optimized, and it is now ready to be used for human studies. They have obtained another NIOSH-R21 grant to apply this system in occupational health to investigate the association between Mn exposure and neurological effects. This will be the first study to investigate the health effects of Mn exposure using a biomarker that represents cumulative long-term Mn exposure.

Publications that are credited to this project include:

Liu Y, Koltick D, Byrne P, Zheng W, Nie LH [2013]. Development of a transportable neutron activation analysis system to quantify Mn in bone in vivo—feasibility and methodology. *Physiol Meas* 34:1593–1609.

Liu Y, Byrne P, Wang H, Koltick D, Zheng W, Nie LH [2014]. A compact DD neutron generator-based NAA system to quantify manganese (Mn) in bone in vivo. *Physiol Meas* 35:1899–1911.

O’Neal SL, Hong L, Fu S, Jiang W, Jones A, Nie LH, Zheng W [2014]. Manganese accumulation in bone following chronic exposure in rats: steady-state concentration and half-life in bone. *Toxicol Lett* 229:93–100.

Statistical Analyses for Assessing Space-Time Exposure Data

PI: Koehler

Colorado State University K01OH009886

Technological advancements in exposure assessment, a necessary component of intervention, control, and compliance, have recently increased the accuracy, reliability, and affordability of portable, direct-reading monitors. These monitors can rapidly assess worker exposures to occupational hazards. By coupling the estimated exposure with a known location, an industrial hygienist has the ability to connect exposures to specific sources. Contour plots of the hazard concentration over space, known as hazard maps, have recently been used to assess the spatial variability of hazards. Hazard maps have the potential to be powerful because they are easily comprehensible for managers, exposed employees, and occupational health scientists to locate areas of concern. Reducing or eliminating exposures in these areas will improve worker health. The goal of this project is to evaluate several statistical approaches for the analysis of workplace exposure data collected with direct-reading instruments.

This study resulted in six large data sets at two locations to evaluate hazard mapping statistical models. Direct-reading monitors were deployed as both static monitors that capture high temporal resolution at a single location and roving monitors that capture high spatial resolution by sampling only a small number of times at each location. Each static monitor collected 10-second (noise) or 1-minute (aerosol) data for approximately 3 hours per sampling day, resulting in 1,080 or 180 measurements per monitor per sampling day. The roving monitors typically made two to four passes of the grid per sampling day. The combination of these two monitor types resulted in over 10,000 location-time-concentration data points on a given day of sampling. This level of resolution was far more than necessary for real exposure assessments, yet it was crucial to generate representative (i.e., “true”) concentration maps and allow for proper evaluation of simpler statistical methods. Their results showed that maps created from roving monitor data were subject to substantial bias in facilities with high temporal variability. They are developing guidelines for data sampling strategies that are expected to provide accurate mapped concentration estimates and standard deviations while remaining conceptually simple enough to be implemented by a wide array of scientists as well as practicing industrial hygienists.

Publications that are credited to this project include:

Koehler KA Peters T [2013]. Influence of analysis methods on interpretation of hazard maps. *Ann Occup Hyg* 57(5):558–570.

Lake K, Zhu J, Wang H, Volckens J, Koehler K [in press]. Effects of data sparsity and spatiotemporal variability on hazard maps of workplace noise. *J Occup Environ Hyg*.

C. Other Cooperative 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 FY2013, NIOSH funded the state surveillance program to support the 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

Our state surveillance program supports the capacity development among states to conduct surveillance of occupational injuries, diseases, deaths, and hazards and 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. Please see the [State Surveillance Portfolio Annual Performance Reports](#) for more information on these state-based initiatives.

b. Public Health Relevance

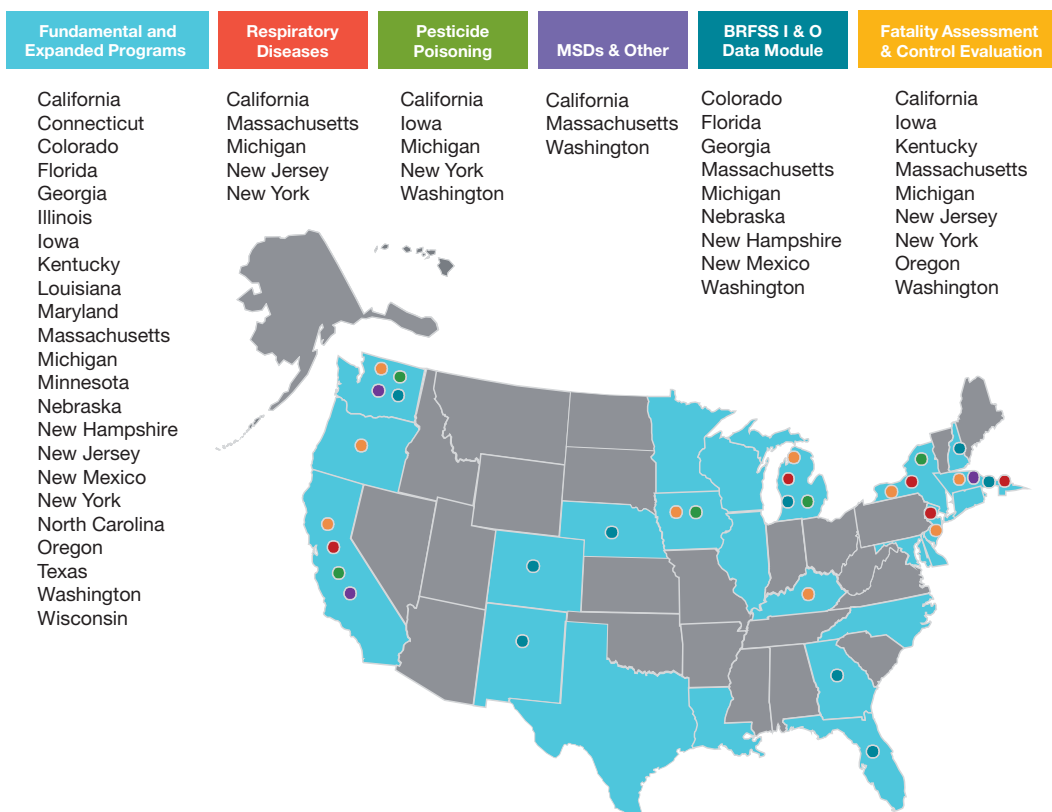
The NIOSH surveillance research program acknowledges and values the contribution of state programs in occupational safety and health surveillance. NIOSH provides financial and technical assistance to state health and labor agencies to develop and expand OH surveillance program capacity. The extramural surveillance portfolio is comprised of 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 the use and dissemination of OH surveillance data for identifying the incidence and prevalence of occupational injuries, illnesses, deaths, and exposures; identification of OH 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 to conduct outreach and engage partners in public health and safety for advancement of "data into action."

c. Public Health Impact

- 162 professional presentations and workshops
- 13 new state guidance

- 23 state surveillance annual reports
- 23 website-based educational and training materials
- 20 states with data contributed to other public health data portals (e.g., CSTE, EPHT portal)
- 2 states' success stories on other public websites (e.g., CSTE)
- 2 state surveillance electronic newsletters

NIOSH State Surveillance in Occupational Health



d. Funding

Institution	PI last name	Start date	End date
California Public Health Institute	Harrison	7/01/2005	6/30/2015
Colorado State Department	Miller	7/01/2010	6/30/2015
Connecticut State Department of Public Health	St. Louis	7/01/2005	6/30/2015
Florida State Department of Health	Watkins	7/01/2010	6/30/2015
Georgia Division of Public Health	Bayakly	7/01/2010	6/30/2015
Iowa State Department of Public Health	Gergely	7/01/2006	6/30/2015
Louisiana State Office of Public Health	Dugas	7/01/2005	6/30/2015
Maryland State Department of Health	Mitchell	7/01/2010	6/30/2015
Massachusetts State Department of Public Health	Davis	7/01/2005	6/30/2015
Michigan State University	Rosenman	7/01/2005	6/30/2015
Minnesota State Department of Health	Williams	7/01/2010	6/30/2015
NC State Department of Health and Human Services	Higgins	7/01/2010	6/30/2015
Nebraska State Department of Health and Human Services	Safranek	7/01/2010	6/30/2015
New Jersey State Department of Health	Lumia	7/01/2005	6/30/2015
New Mexico State Department of Health	Landen	7/01/2005	6/30/2015
New York Center of Environmental Health	Gelberg	7/01/2005	6/30/2015
NH State Department of Health	Armenti	7/01/2010	6/30/2015
Oregon Public Health Services	Douglas	7/01/2005	6/30/2015
Texas State Department of Health Services	Villanacci	7/01/2006	6/30/2015
University of Illinois	Forst	7/01/2010	6/30/2015
University of Kentucky	Bunn	7/01/2008	6/30/2015
Washington State Department	Bonauto	7/01/2005	6/30/2015
Wisconsin Department of Health Services	Anderson	7/01/2005	6/30/2015

e. Outputs

Peer-reviewed publications and impact factor

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, and PubMed database. From October 1, 2012, to September 30, 2013, there were eight publications across state surveillance program grants (Activity Codes = U60). The journal most frequently published in was the *Journal of Occupational and Environmental Hygiene*, with two publications in FY2013. A searchable database of NIOSH publications can be found at [Grantee Award Final Reports and Publications](#) on the OEP webpages.

Across the eight publications, the average impact factor rating was 1.954 with the range extending from 1.042 for *Traffic Injury Prevention* to 3.730 for *PLOS One*.

f. Selected Stories of Impact

California occupational health and safety surveillance

Program staff increased the reach of the electronic program newsletter (e-OHW) by arranging for member distribution through trade associations, such as the American Industrial Hygiene Association, and reposting information on labor, trade association, and public health blogs, listservs, and publications. For example, the June 2013 edition about a lead surveillance report was reposted in the Leadnet listserv, the NY COSH e-newsletter, the Western Occupational and Environmental Medical Association e-newsletter, and the Pump Handle and the Robert Wood Johnson Foundation blogs.

Iowa occupational health and safety surveillance

Program staff analyzed 18 years of data for fatalities involving grain activities from the Iowa FACE program and presented the findings as part of the Midwest Region Agricultural Safety and Health Conference in November 2012. The data have been included in the grain fatality and injury database maintained by Purdue University, which was referenced in numerous media articles.

Washington occupational health and safety surveillance

Prevention resources were disseminated by email predominantly to health and safety professionals. The WA FACE web-based electronic survey provides valuable feedback from these users and documents the quality, uses, and impact of WA FACE prevention resources on workplace safety. Of 57 total respondents, 92% considered WA FACE products “Good to Excellent” resources in terms of usefulness and readability.

The Trucking Industry Surveillance subprogram is responding to stakeholder feedback by continuing to produce safety materials and online training simulations. One of the largest truck driver staffing agencies in the nation contacted program staff regarding the jump force simulation and to arrange for simulation stations or demos in each of their 42 offices.

Oregon occupational health and safety surveillance

Program staff were involved in extensive distribution of educational and prevention materials and website downloads for the protection of workers and to promote safe, healthy workplaces.

- Over 200 annual reports distributed via listserv and promoted via CROET Facebook and Twitter.
- 211 Fallers Logging Safety booklets distributed via mail by request.
- 100 Young Workers: Stay Alive on the Job! booklets distributed via mail by request.
- 6,286 website views annually, 523 average monthly website views, 98 average monthly document downloads.

Michigan occupational health and safety surveillance

Twelve state OSHA enforcement inspections benefitted workers exposed to asthma-causing substances in that health and safety violations must be corrected, which led to overall safer and healthier work environments. The program provided advisory letters to 21 symptomatic individuals to see a physician for follow-up for their respiratory symptoms.

Program (FACE) written materials have been cited in several publications and used by organizations in their educational outreach materials: Michigan FACE work-related fatality statistics were cited by the state OSHA Consultation, Education, and Training Division to educate prospective grantees about the Michigan industries and occupations with a high fatality rate to be used during their request for proposal.

New York State occupational health and safety surveillance

Program recommendations were officially adopted by the Precast/Prestressed Concrete Institute (PCI) and incorporated into the 2012 version of the PCI manual *Erection Safety for Precast and Prestressed Concrete*. PCI develops and maintains the standards for designing, fabricating, and constructing precast concrete structures for the construction industry. The manual has been used by the construction industry as a technical and safety standard. OSHA has been using the manual as a consensus industry standard for enforcement.

Collaboration with the New York Center for Agricultural Medicine and Health provided respiratory protection training, medical clearance, and fit testing to farm workers and farm owners, in both English and Spanish. Ninety-three farmworkers and farm owners trained on proper respirator protection, and 59 were professionally fit tested.

Massachusetts occupational health and safety surveillance

In response to the dissemination of *Protect the Crossing Guards that Protect Our Children*, the Registry of Motor Vehicles disseminated it to over 100 school bus drivers and added information about crossing guards to the June 2013 edition of the Massachusetts driver's manual. In response to the outreach, the National Solid Waste Management Association disseminated *Temporary Agencies and Worksite Employers Share Responsibility for Keeping Temporary Workers Safe* to their safety committee and to all members. Program (FACE) reports were used as a teaching tool in several courses at the Harvard School of Public Health, University of Massachusetts at Lowell and Northeastern University.

New Jersey occupational health and safety surveillance

Mining is the second-leading industry sector associated with silicosis cases in New Jersey. The Program conducted educational outreach to 69 active surface mines in New Jersey. All materials that were distributed, as well as the supporting statistics, can be found on the new "Silicosis in Mining" webpage (<http://www.nj.gov/health/silicosis/mining/index.shtml>). Another major accomplishment was the creation of a new Occupational Health Indicators (data) webpage (http://nj.gov/health/surv/nj_ohi.shtml) featuring written narratives and completed trend analyses for 18 indicators. This milestone provides stakeholders and the public with quick access to comprehensive New Jersey occupational health and safety statistics.

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. Public Health Impact

- CATS technology makes diary studies with Latino samples feasible.
- Analysis found that recent immigrants are at risk for not receiving no-cost, employer-provided personal protective equipment.
- Results obtained from this exploratory/developmental project provided concrete recommendations for refining future implementations of automated survey technology with immigrant Latino workers.

d. Funding

Institute	PI last name	Start date	End date
Virginia Polytechnic Institute and State University	Kleiner	09/01/2009	08/31/2014

e. Outputs

Peer-reviewed publications

From October 1, 2012, to September 30, 2013, there were three publications for the construction research cooperative agreement. A searchable database of NIOSH publications can be found at [Grantee Award Final Reports and Publications](#) on the OEP webpages.

f. Selected Stories of Impact

CATS technology makes diary studies with Latino samples feasible

The aim of this project was documenting Latino construction workers' participation rates, attrition levels, and adherence to a 21-day end-of-day daily diary protocol using a completely automated telephone survey (CATS) and follow-up over 3 months. Study results indicated that over one-third (37%) of the recruited sample adhered to the 21-day protocol, a comparable percentage (38.7%) initiated but did not adhere to the protocol, and 24% never began the diary protocol. Adherence was generally not predicted by demographic, health- or job-related characteristics, suggesting few sources of systematic bias in adherence.

Collected data were of sufficient quality to provide a foundation for three published peer-reviewed papers. For example, they published a paper that describes work safety climate among Latino residential construction workers, delineates differences in work safety climate by personal and employment characteristics, and determines associations of work safety climate with specific work safety behaviors. Work safety climate predicts subsequent safety behaviors among Latino residential construction workers, with differences by trade being particularly important.

Immigrant's use of personal protective equipment

Another analysis used cross-sectional data from a community-based sample of Latino construction workers in Western North Carolina (N = 119) to describe receipt of employer-provided PPE by construction workers, document sources of variation in the receipt of employer-paid PPE, and delineate associations of employer-paid PPE with workers' regular use of PPE. The results suggest substantial deviation in residential construction subsector from regulations requiring employers to provide workers with PPE at no cost. Analyses also suggest recent immigrants are most at risk for not receiving no-cost, employer-provided PPE and that employer provision of no-cost PPE may promote more regular use by Latino construction workers.

Exploratory/developmental projects on CATS technology

Results obtained from their exploratory/developmental project provided concrete recommendations for refining future implementations of CATS technology with immigrant Latino workers. A key area of refinement discovered was the quality of the computerized "voice": it was reported by participants to sound artificial and as though it had an echo. They learned this could be addressed by using special features of the program (specifically UTF-8 Unicode as opposed to U.S. ANSI standard character encoding) to better exploit characters, such as the Spanish accents and the tilde, to produce more authentic sounds. We also learned other programming options to help the system differentiate participants' voices from ambient background noise over the telephone. These refinements have been incorporated into their current project using CATS technology to evaluate a Lay Health Advisor safety training program among Latino roofers.

3. Hurricane Sandy

a. Overview

Hurricane Sandy was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season, as well as the second-costliest hurricane in United States 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: (a) conduct training in mold mitigation and health-related research and (b) 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.

b. Public Health Relevance

The research program supports 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. The research also addresses the 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 adverse public health outcomes and inform public health programs and processes.

c. Public Health Impacts

During FY2013, all projects in this portfolio were in the first year of grant activity and had not achieved public health impacts at this early stage.

d. Funding

Institution	PI last name	Start date	End date
University of Connecticut	Schenck	9/30/2013	9/29/2015
Queens College	Markowitz	9/30/2013	9/29/2015
New York Medical College	Reilly	9/30/2013	9/29/2015
New Jersey State Department of Health and Senior Services	Lumia	9/30/2013	9/29/2015
Rand and Lifeline group	Shih and Chaisson	9/30/2013	9/29/2015

e. Outputs

During FY2013, all projects in this portfolio were in the first year of grant activity and had not achieved research outputs at this early stage.

f. Selected Stories of Impact

During FY2013, all projects in this portfolio were in the first year of grant activity and had not achieved public health impacts at this early stage.

4. Training Project Grants (TPG)

a. Overview

NIOSH supports professional training in occupational safety and health in single disciplines through [Training Project Grants \(TPGs\)](#). TPGs are individual academic training programs that support undergraduate and graduate training in a single discipline. These programs compliment the national network of graduate training provided by ERCs and are located throughout the United States.

b. Public Health Relevance

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

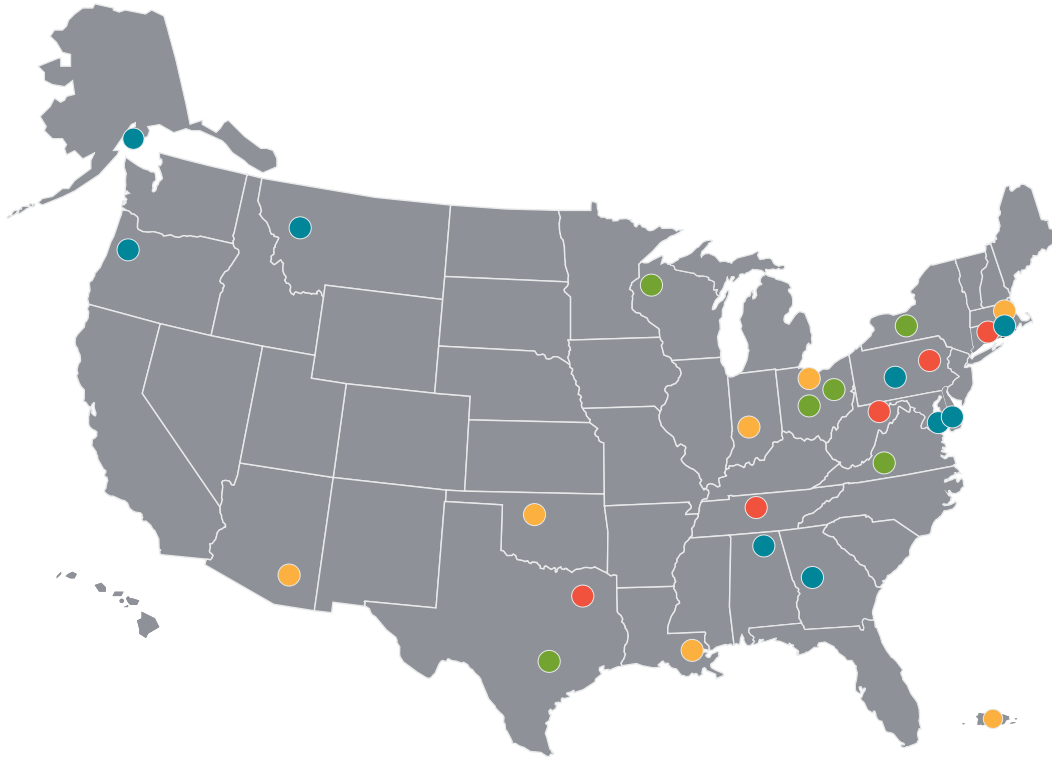
c. Public Health Impact

- International Association of Firefighters' trainers and trainees quickly responded to the Boston Marathon bombing, analyzing, planning and implementing an appropriate emergency response, minimizing loss of life with such traumatic injuries that had occurred.
- Findings of occupational medicine residents from the University of Pennsylvania were accepted and presented at a national conference.
- Alaska Marine Safety Education Association continues to impact public health through training in one of our nation's dangerous professions: commercial fishing.
- Graduates of TPGs continue to be hired for safety and health positions across federal, state, and local agencies including OSHA, MSHA, and NIOSH.
- David Vearrier, MD, MPH, occupational medicine resident at the University of Pennsylvania, was recognized for excellence in research and received the Resident Research Award at the National American Occupational Health Conference.

Training disciplines supported by FY2013 TPG awards are shown in the map below.

NIOSH Training Project Grants

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



d. Funding

Institution	PI last name	Start date	End date
Alaska Marine Safety Education Association	Dzugan	7/01/2011	6/30/2016
Association of Occupational And Environmental Clinics	Harrison	7/01/2013	6/30/2018
Emory University	Tolbert	7/01/2012	6/30/2017
International Association Fire Fighters	Morrison	9/30/2012	9/29/2017
Meharry Medical College	Chakrabarty	7/01/2011	6/30/2016
Millersville University	Specht	7/01/2009	6/30/2014
Montana Tech	Jensen	7/01/2013	6/30/2018
Murray State University	Kraemer	7/01/2010	6/30/2015
Ohio State University	Sommerich	7/01/2011	6/30/2016
Ohio State University	Schwerha	7/01/2012	6/30/2015
Portland State University	Hammer	7/01/2010	6/30/2015
Purdue University	Rosenthal	7/01/2011	6/30/2016
State University of New York	Paquet	7/01/2010	6/30/2015
Texas A&M University Health Science Center	Congleton	7/01/2012	6/30/2017
Tulane University	Grimsley	7/01/2012	6/30/2015
University of Arizona	Burgess	7/01/2012	6/30/2017
University of Connecticut	Magley	7/01/2010	6/30/2015
University of Massachusetts-Lowell	Kriebel	7/01/2010	6/30/2015
University of North Alabama	Figueroa	7/01/2012	6/30/2017
University of Oklahoma	Phillips	7/01/2009	6/30/2014
University of Pennsylvania	McKenzie	7/01/2009	6/30/2014
University of Puerto Rico	Gonzalez	7/01/2013	6/30/2018
University of Texas Health Science Center Houston	Levin	7/01/2010	6/30/2015
University of Toledo Health Science	Akbar	7/01/2009	6/30/2014
University of Wisconsin-Stout	Sorrell	7/01/2010	6/30/2015

e. Outputs

Trainees, graduates, and employment of graduates

In academic year 2012–2013, 208 professionals graduated from the TPG training programs with specialized training in disciplines that include industrial hygiene, occupational safety, occupational medicine, and occupational safety and health. Of the 208 TPG graduates, 207 (97%) entered the OSH workforce.

Program area	Trainees	Graduates	Employed in OSH field or seeking advanced training
Industrial Hygiene	102	30	27 (90%)
Occupational Safety	147	60	58 (97%)
Occupational Medicine	28	12	12 (100%)
Occupational Safety and Health	696	106	104 (98%)
Total	973	208	207 (97%)

Peer-reviewed publications and impact factor

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, and PubMed database. From October 1, 2012, to September 30, 2013, there were three publications across Training Project Grants (Activity Codes = T01 and T03). A searchable database of NIOSH publications can be found at [Grantee Award Final Reports and Publications](#) on the OEP webpages.

There were too few publications with impact factors to compute an average impact factor rating for these publications.

f. Selected Stories of Impact

Training in Action: The Boston Marathon

On April 15, 2013, the International Association of Fire Fighter's (IAFF) was conducting NIOSH-funded training for new fire fighter recruits of the Boston Fire Department (BFD) when two pressure cooker bombs exploded during the Boston Marathon, killing 3 people and injuring an estimated 264 others. Although training for these new recruits was disrupted, IAFF instructors, also members of the BFD, had an opportunity to put their IAFF training to good use. Working with other IAFF/NIOSH-trained BFD members, they used their skills to analyze, plan, and implement the emergency response, just as they were taught. As a result, the loss of life was very low compared with the traumatic injuries. Since this terrible event, BFD has implemented department-wide training of IAFF/NIOSH programs to ensure responders are always prepared in the future.

Occupational Health Psychology Summer Institute: Health Protection and Health Promotion

Summer Institute is a bi-annual event to provide occupational health psychology training to individuals from public and private sectors. The Institute focuses on current topics that

clearly integrate both health protection and health promotion such as effective interventions in the areas of safety and health. Directed by TPG Program Director Leslie Hammer, PhD, the event brings together researchers and practitioners to advance worker health and safety.

Occupational Health Internship Program (OHIP)

In 2013, NIOSH TPG, the Association of Occupational and Environmental Clinics, completed a survey to determine the impact of their NIOSH-supported Occupational Health Internship Program (OHIP). With a high response rate, almost 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 OSH professionals.

Preventing work-related injuries, illnesses and fatalities

As a unique TPG, the Alaska Marine Safety Education Association (AMSEA) is a collaboration of state and federal organizations that provide training to prevent drownings in one of our nation's more dangerous jobs—commercial fishing. Each year, AMSE provides feedback on the impact of their training. In 2012–2013, AMSEA documented 36 fishermen who claimed that their training had helped them survive an emergency on their fishing vessels. This does not include the additional 40 plus crewmembers that were onboard these vessels and were also survivors. For example, in March 2013, two AMSEA trainers from New Bedford, Massachusetts, received a call from a fisherman they had been conducting monthly emergency drills with. The captain said, “Thanks for being persistent and faithfully conducting monthly drills. We just had a man overboard and we were able to rescue him.” The captain stated that the monthly drills were a big part of the successful recovery.

TPG graduates are hired by federal agencies to promote and protect worker health and safety through training, outreach, and enforcement. An example is through the University at Buffalo, SUNY's Occupational Safety and Health TPG. A graduate joined the OSHA Albany Office in 2012, after completing an internship in Buffalo's OSHA Office. The area director of the Buffalo OSHA Office provided this feedback to SUNY: “The interns that the [NIOSH Training Project] has provided come to us with an enhanced understanding of safety and health. Part of my responsibility is to help develop the next generation of leaders in the field. Your program continues to be an excellent resource in support of that goal.” Three UB SUNY occupational safety and health trainees have been hired by OSHA since 2008.

With an emphasis on mine health and safety, the University of Arizona's Industrial Hygiene Graduate Program provides training and support services to mine operators throughout Arizona. Faculty and industrial hygiene students have conducted on-site training for underground and surface mining operations. Topics included noise, radon, and total respirable dust monitoring—all topics with significant health impacts for miners. Training was provided to miners, supervisors, and safety personnel.

Accomplishments of TPG trainees: research to practice

At one of NIOSH's newest funded TPGs—Ohio University—faculty and students conducted an extensive lighting study and a study of automated external defibrillators at Ohio University through collaboration with the university's Department of Safety. Results of the studies were presented to the Ohio University President's Advisory Council on Safety.

At Emory University's Occupational Epidemiology TPG, led by Professor Paige Tolbert, NIOSH-supported students have been recognized for their contributions in safety and health research through awards, acceptance of conference abstracts, and numerous publications in journals with high impact scores.

5. Emergency Responder Training Program

a. Overview

NIOSH funds a unique TPG in Emergency Responder Training Program through the International Association of Fire Fighters (IAFF). This grant supports a comprehensive nationwide hazardous substance training program for fire fighters, paramedics, and other emergency responders across the United States. The IAFF has had a long-standing relationship with NIOSH since 1991; the IAFF has conducted 2,946 training deliveries, trained over 62,178 students, and logged 1,270,328 contact hours. Under NIOSH funding, the IAFF currently delivers the following training: First Responder Operations; Confined Space Operations; and Emergency Response to Terrorism—Operations, Illicit Drug Labs, Infectious Diseases and Chemical Process Industries.

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.

c. Public Health Impact

- The IAFF exceeded its projected goals for training in FY 2013.
- A total of 184 classes were delivered and 3,528 students were trained over 61,080 contact hours (project period 10/1/12–9/30/13).
- In April 2013, the IAFF was approved by the National Board on Fire Service Professional Qualifications for accreditation of its First Responder Operations program.
- IAFF training is a proven resource that directly impacts decisions made in real-world scenarios fire fighters experience every day.
- IAFF has developed training partnerships with thousands of fire departments throughout the United States.

d. Funding

Institution	PI last name	Start date	End date
International Association of Fire Fighters	Morrison	9/30/2012	9/29/2017

e. Outputs

The IAFF exceeded its projected goal of conducting training courses and training classes in FY2013. A total of 184 classes were delivered and 3,528 students were trained over 61,080 contact hours (project period 10/1/12–9/30/13). The following table shows the classes provided to more than 3,500 students.

FY13 Training Class Breakdown

Class title	No. of classes	No. of students	No. of contact hours
FRO (24 HR)	76	1,626	39,024
CPI (8 HR)	46	771	6,168
Drug Lab (8 HR)	29	444	3,648
ERT-Ops (8, 16, 24 HR)	23	467	7,424
CSO (24 HR)	10	220	4,816
Totals	184	3,528	61,080

f. Selected Stories of Impact

The Illicit Drug Labs and First Responder Operations curriculum

The Illicit Drug Labs curriculum was updated to include the most recent information available from the Drug Enforcement Administration regarding illicit drug lab seizures. The instructor guide and student manuals will be updated and then reproduced for future deliveries.

The department is nearing completion of the revision of the First Responder Operations curriculum. The revised instructor guide, student manual, and multimedia presentations will meet the 2013 Edition of NFPA 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents. The curriculum now includes:

- Two days of classroom instruction and one day of skills instruction, practice, and testing
- New presentation slides including video, photos, animations, and diagrams
- Twenty new videos including container identification, skills performance, and a simulated hazmat transportation incident

Accreditation by the National Board on Fire Service Professional Qualifications

In April 2013, the IAFF was approved by the National Board on Fire Service Professional Qualifications (Pro Board) for accreditation of its First Responder Operations program. The Pro Board is an internationally recognized means of acknowledging professional

achievement in the fire service and related fields. Full implementation of the program was completed in September 2013. Students who successfully complete the First Responder Operations program are now eligible for the following Pro Board Certifications:

- Hazardous Materials Awareness—NFPA 472, Chapter 4 2013 edition
- Hazardous Materials Operations—NFPA 472, Chapter 5, Core Competencies, 2013 edition
- Hazardous Materials Operations—NFPA 472, Chapter 6.2, Mission-specific Competencies: Personal Protective Equipment, 2013 edition
- Hazardous Materials Operations—NFPA 472, Chapter 6.6, Product Control, 2013 edition

Instructor Development Conference

The IAFF held its annual Instructor Development Conference in Clearwater, Florida, on November 27–29, 2012. The conference is the IAFF’s primary medium to directly convey course updates, administrative changes, and new training technologies to the instructor cadre. The conference format consisted of a combination of plenary sessions, speakers, and curricula development breakout workshops, as well as new department initiatives. For example, the IAFF conducted a curricula review workshop in which the Emergency Response to Terrorism 16-Hour Train the Trainer course was reviewed by the instructor cadre. Curricula development breakouts for the First Responder Operations, Confined Space Operations, Confined Space Rescue, and HazMat Technician programs were also conducted with the instructor cadre.

In conjunction with the conference, the Hazardous Materials/Weapons of Mass Destruction (HazMat/WMD) Advisory Board met simultaneously in Clearwater, Florida, in November 2012. The advisory board includes 12 members who represent fire/rescue service, labor, public health, academia, and industry. The advisory board provides oversight for IAFF HazMat/WMD grants, advises the program director, and makes recommendations regarding program content and delivery. The advisory board reviewed the conference agenda, updated curricula and 2013 training goals, and reviewed grant funding sources. The new Pro Board initiative was also presented.

Chemical safety incidents

Chemical safety incidents continue to occur in industries such as chemical plants, ethanol plants, refineries, and anhydrous ammonia facilities that use highly hazardous chemicals that may be toxic, reactive, flammable or explosive, or may exhibit a combination of these properties. The Chemical Safety Board noted in a 2006 report to Congress that over a 12-month period they screened some 645 chemical accidents, an average of almost two a day. “The consequences of 18 of these accidents—including deaths, injuries, property damage, public impact, or environmental harm—were serious enough to rate ‘medium’ to ‘high’ priority in the agency’s scoring system for chemical accidents.” (Strategic Plan—Fiscal Years 2008–2012, U.S. Chemical Safety Board).

Fire fighter training/collaborations

IAFF training is a proven resource that directly impacts decisions made in real-world scenarios fire fighters experience every day. For example, at Intel in Chandler, Arizona, several large incidents occurred that involved chemical processes. The incident at Intel involved the mixing of acids to facilitate their fabrication process, and the cooling system was not capable of keeping up with the reaction that took place. This incident lasted approximately 12 hours and took approximately 75 hazmat technicians/first responders to mitigate the response. Based on this incident, the state of Arizona requested Chemical Process Industry training from the IAFF. Not only did the IAFF train 700 students during 42 classes, but the local jurisdictions—Glendale, Scottsdale, Tempe, and Gilbert—joined forces with local industry in an effort to build greater working relationships prior to future incidents occurring. A summary of student comments are listed below:

- Informative, clear, descriptive.
- Instructors were very dynamic.
- Quality review of the NIOSH Pocket Guide.
- Good use of audio/visual resources.
- Class was interactive.
- PowerPoint presentations were thorough.
- Course will make hazmat calls easier to “size up.”
- Student/teacher interaction helped us become involved.
- Useful job-related information.
- Easy to understand.
- Raised my awareness for hazmat calls in my first-due area.
- Provided real-life scenarios that catered to field personnel.

In addition, the IAFF has developed training partnerships with thousands of fire departments throughout the United States. Many of the departments, like the Fire Department of New York (FDNY), have relied on the IAFF program to properly educate their personnel. In the decade following the tragic events of 9/11, the IAFF has been the only organization to provide hazmat training to FDNY recruits and remains the only organization to continue hazmat training for FDNY. Newly acquired Pro Board accreditation has further enhanced the desire and interest among additional states and jurisdictions to use and/or adopt IAFF training programs.

6. Western Mining Training Center

a. Overview

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 mining safety and health training in the western United States since 1999.

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 training that (1) addresses the needs of miners, (2) increases the number of qualified mine safety and health trainers in the western United States, (3) develops and delivers training to mine workers in the western United States, (4) provides qualified instructors and faculty, (5) evaluates training effectiveness and impact on reducing injuries and illnesses to miners, and (6) coordinates with existing training programs, such as those offered by MSHA and MSHA-funded state programs.

b. Public Health Relevance

CDC estimates that more than 11,000 people die at home every year from injuries received from falls, fires, drownings, or poisonings. Although the mine safety and health training conducted by the Colorado School of Mining is directed to workplace hazards, it is also applicable to hazards found in the home and in other settings. For example, the new miner and annual refresher courses include specific instruction on first aid, use of fire extinguishers, slip/trip/fall prevention, and chemical safety. Individuals who apply what they learn for work to other aspects of their life will avoid injuries and be healthier and will also serve as examples to their family members and friends.

The Arizona Center has implemented new training methods and materials and safety-focused leadership competencies that respond in near real time to changing workforce needs and environments of Western U.S. operations. Further, they continue increasing the capacity, tools, and methods to reduce miner exposure risks associated with heat, noise, and aerosol particulates.

c. Public Health Impacts

The Western Mining Safety and Health Training Resource Centers have:

- Increased 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.
- Directed 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.

d. Funding

Institution	PI last name	Start date	End date
Colorado School of Mines	Dagdelen	9/1/2010	8/31/2013
University of Arizona	Poulton	9/1/2010	8/31/2013

e. Outputs

The University of Arizona center trained miners (> 9000), mining supervisors (> 100), and trainers (> 300) from October 2010 to May 2014. The Colorado School of Mines conducted 226 courses from September 2010 to August 2013, including a total of 103 training courses and professional presentations. Post course evaluations completed by trainees indicated that these courses were rated as either excellent or very good by 84 percent of the trainees.

f. Selected Stories of Impact

Mining Institute for Supervisor Leadership (MISL)

The Arizona Training Center created the Mining Institute for Supervisory Leadership (MISL) at the request of their 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 University of Arizona faculty over 2.5-day course sessions. At the completion of the intensive course, participants in the MISL were partnered with a mentor (from the TAC and university faculty) who provides guidance and coaching while the participant undertakes 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 first MISL workshop was held December 1–2, 2011, and has been repeated five times. Typical cohorts are 20–25 supervisors. The cohorts asked for more advanced training after they finished their first round of mentoring, and, in 2013, the Silver-Advanced Leadership Training (SALT) was developed. 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.

More than 100 MISL projects have been completed at mine sites to improve safety ranging from creating new software for safety observations to changing company procedures for electrical safety. Examples of a few MISL projects in recent years that have had positive impact in mining companies include (1) an executive decision leadership team, (2) new operation-wide fall protection program, (3) improved pre-shift safety meetings, (4) standardized execution of improved safety management, (5) hazard recognition, and (6) fatality prevention training with a focus on contractors. The projects have resulted in permanent changes in companies. In addition, the center changed the way safety training is done, with use of active learning techniques based on andragogical principles (adult learning techniques) at several mining companies.

MineSAFE serious gaming software for mine safety training

For more than a decade, those in mine safety training and related fields have been calling for changes in the way new and experienced miners are trained. In a review of more than 30 years of research to improve safety and health training in the mining industry, NIOSH researchers have identified two focal points for future training research:

- Increasing trainee engagement by using more realistic or interactive methods
- Developing and refining methods to evaluate post-training competencies

Prior research suggests realistic and engaging training is more effective and may result in greater transfer to the job. The researchers also identified the potential of “serious games” using virtual reality to create more realistic and engaging training, noting that “the more experience people gain through participating in such role playing simulations, the better prepared they will be to handle real-world events.” The Arizona Training Center has developed MineSAFE (Software Architecture for Mine Safety Education), a new platform to create “serious games” in mine safety education. In designing our platform, we performed a triangulated needs assessment that included product surveys, feedback from industry stakeholders, and informal user studies of existing training software.

The MineSAFE platform is built atop a commercially available game engine with advanced graphics and interaction capabilities. Our platform uses well-established workflows and software practices employed by the gaming industry to expedite development and reduce costs. MineSAFE games can run on computer hardware ranging from middle-range laptops to higher-end workstations and virtual reality theatres, with support for interface devices that include keyboards, mice, gamepads, touch surfaces, and emerging gesture-enabled interfaces. The center has created the NIOSH training exercise Harry’s Hard Choices as a serious game. They have tested the Harry’s Hard Choices game and have received excellent reviews for training effectiveness. The current game contains nearly all of the content required for MSHA annual refresher training. The gaming platform is unique to mining.

Colorado School of Mines

During 2013, the Western Miner Training Program at the Colorado School of Mines (CSM) conducted 74 mine safety and health and mine rescue courses and trained 888 mine workers. Almost all of the mine workers who attended the courses were contractors working on short-term projects at mine sites and had no internal training programs that could provide this type of training. These companies rely solely on CSM mine safety and health courses. Three CSM student mine rescue teams (30 students) received training in both basic and advanced rescue skills relevant to mine emergency responses as well as other types of emergencies occurring at both work and nonwork settings. For example, two students recently were first on scene at a major car accident involving multiple injuries. While waiting for paramedics to arrive, they were able to triage all injured victims and provide first aid to the most severely injured.

Most of the safety and health training and mine rescue training conducted included lessons on first aid, which provided skills sufficient for some of the students to render aid with successful outcomes. One student was with a friend who received stabbing wounds during an

attack. With the knowledge he had learned from the classes, the student was able to provide first aid to his friend while waiting for the paramedics to arrive on scene. Another student, who choked on a piece of food, was able to successfully administer the Heimlich maneuver to himself. A mine worker, who also learned how to do the Heimlich maneuver during a new miner course, was able to successfully perform this maneuver on his young son who was choking on a bottle cap. He told this information to other students in his annual refresher course to emphasize the relevance of the training.

7. Small Business Innovation Research Grants

a. Overview

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 or research and development needs by increasing the commercial application of federally supported research results.

b. Public Health Relevance

This unique portfolio encourages participation by socially and economically disadvantaged small businesses and women-owned businesses to improve the return on investment from federally funded research for economic and social benefits to the Nation. SBIR annual reports provide regular updates on activities and outcomes. Included here are a diverse array of efforts to focus research, information, and service for small businesses.

c. Public Health Impacts

During FY2013, all projects in this portfolio were in the first year of grant activity and had not achieved public health impacts at this early stage.

d. Funding

Institution	Activity	PI Last Name	Start date	End date
Aerosol Dynamics, Inc.	Phase I	Hering	09/01/2013	08/28/2014
Faraday Technology, Inc.	Phase I	Inman	09/01/2013	08/31/2014
Adaptive Technologies, Inc.	Phase I	Abbott	09/01/2013	08/31/2014
Physical Optics Corporation	Phase I	Milovanov	09/01/2013	02/28/2014
Physical Optics Corporation	Phase II	Matthews	09/01/2013	08/31/2014

e. Outputs

One of the five SBIR project was a Phase II follow-on research that is the result of successful completion of Phase I projects.

f. Selected Stories of Impact

During FY2013, all projects in this portfolio were in the first year of grant activity and had not achieved public health impacts at this early stage.



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