NATIONAL OCCUPATIONAL RESEARCH AGENDA

UPDATE 2001

NORA™

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

NORA Teams

Bold type indicates team leaders

Allergic & Irritant Dermatitis

Boris D. Lushniak (NIOSH) bdt1@cdc.gov
G. Frank Gerberick (The Proctor and Gamble Company) gf@pg.com
Stephen P. Berardinelli (NIOSH)
David Bernstein (University of Cincinnati)
Raymond E. Biagini (NIOSH)
Mark F. Boeniger (NIOSH)
Richard Fenske (University of Washington)
James S. Johnson (Lawrence Livermore National Laboratory)
Michael Luster (NIOSH)
Alan N. Moshell (National Institute of Arthritis and Musculoskeletal and Skin Diseases/NIH)
Albert E. Munson (NIOSH)
James S. Taylor (Cleveland Clinic)
Susan Q. Wilburn (American Nurses Association)

Asthma & Chronic Obstructive Pulmonary Disease

Paul Henneberger (NIOSH) pkh0@cdc.gov
John Balmes (University of California, San Francisco)
Raymond E. Biagini (NIOSH)
Robert Castellan (NIOSH)
Tom Croxton (National Heart, Lung, and Blood Institute/NIH)
Jeffrey Fedan (NIOSH)
Susan Kennedy (University of British Columbia)
Hillel Koren (Environmental Protection Agency)
Kathleen Kreiss (NIOSH)
Edward Petsonk (NIOSH)
Gregory Wagner (NIOSH)
David Wegman (University of Massachusetts, Lowell)
David Weissman (NIOSH)

Cancer Research Methods

Paul Schulte (NIOSH) pas4@cdc.gov
Elizabeth M. Ward (NIOSH) emw3@cdc.gov
Steve Bayard (Occupational Safety and Health Administration)
Aaron Blair (National Cancer Institute/NIH)
Mary Ann Butler (NIOSH)
Dave Dankovic (NIOSH)
Ann F. Hubbs (NIOSH)
Carol Jones (Mine Safety and Health Administration)
Myra Karstadt (Environmental Protection Agency)
Gregory L. Kedderis (Chemical Industry Institute of Toxicology)
Ronald Melnick (National Institute of Environmental Health Sciences/NIH)
Paul Brandt-Rauf (Columbia University)
Carrie A. Redlich (Yale University)
Nathaniel Rothman (National Cancer Institute/NIH)
Russell Savage (NIOSH)
Michael Sprinker (International Chemical Workers)
Mark Toraason (NIOSH)
Ainsley Weston (NIOSH)

Control Technology & Personal Protective Equipment

Laurence Reed (NIOSH) ler3@cdc.gov
Dale Avery (NIOSH)
Stephen Berardineli (NIOSH)
Donald Campbell (NIOSH)
David deVries (American Society of Safety Engineers)
Richard Duffy (International Association of Fire Fighters)
Mike Flynn (University of North Carolina)
Bill Heitbrink (NIOSH)
Bill Kojola (AFL-CIO)
Steve Mallinger (Occupational Safety and Health Administration)
Ernest Moyer (NIOSH)
Michael Seymour (Occupational Safety and Health Administration)
Daniel K.Shipp (Industrial Safety Equipment Association)
Jenny Topmiller (NIOSH)
Fred Kissell (NIOSH)

Emerging Technologies

Aaron Schopper (NIOSH) aws0@cdc.gov
Nicholas Ashford (Massachusetts Institute of Technology)
George Bockosh (NIOSH)
Kenneth D. Brock (Liberty Mutual Insurance Group)
Tai Chan (General Motors Corporation)
David Conover (NIOSH)
Janet S. Flynt (Underwriters Laboratories Inc.)
Jack Geissert (Genetics Institute, Inc.)
Matt Gillen (NIOSH)
James Jones (NIOSH)
Raymond Levott (The National Environmental Education and Training Center)
Maureen Ruskin (Occupational Safety and Health Administration)
Paul Schlecht (NIOSH)
Randal P. Schumacher (The Jefferson Group)
John Sparks (Environmental Protection Agency)
Jeffrey Welsh (NIOSH)

Exposure Assessment Methods
Mary Lynn Woebkenberg (NIOSH) mlw2@cdc.gov
Martin T. Abell (NIOSH)
Thomas W. Armstrong (Exxon Biomedical Sciences, Inc.)
Gayle DeBord (NIOSH)
Dennis W. Groce (NIOSH)
Mike Keane (NIOSH)
Paul Knechtges (U.S. Army Center for Environmental Research)
David K. Pegram (Department of Energy)
Beth D. Reh (NIOSH)
Bonnie Rogers (American Association of Occupational Health Nurses)
Gary Spies (Monsanto Company)
Mark Stenzel (Occidental Chemical Corporation)
David F. Utterback (NIOSH)
James Weeks (George Washington University)
Kenneth L. Williams (NIOSH)

Fertility & Pregnancy Abnormalities

Teresa Schnorr (NIOSH) ths1@cdc.gov
Sally Perreault Darney (Environmental Protection Agency)
George Daston (The Procter and Gamble Company)
Barbara Grajewski (NIOSH)
Tina Lawson (NIOSH)
Michele Marcus (Emory University)
Donald Mattison (March of Dimes)
Melissa McDiarmid (University of Maryland)
Eisuke Murono (NIOSH)
Wendie Robbins (University of California, Los Angeles)
Margaret Ryan (Department of Defense)
Steven Schrader (NIOSH)
Mike Shelby (National Institute of Environmental Health Sciences/NIH)

Health Services Research

Scott D. Deitchman (NIOSH) sed2@cdc.gov
Joan Buchanan (Harvard University)
William Bunn (Navistar International Transportation Corporation)
Mary A. Cummings (Agency for Health Care Policy and Research)
James Ellenberger (AFL-CIO)
Jay Himmelstein (University of Massachusetts)
Theodore M. Katz (NIOSH)
Kent W. Peterson (Occupational Health Strategies, Inc.)
Gordon Reeve (Ford Motor Company)
Kathleen Rest (NIOSH)
Linda Rudolph (California Department of Industrial Relations)
Rosemary Sokas (NIOSH)
Gregory Wagner (NIOSH)

Hearing Loss

John Franks (NIOSH) jrf@cdc.gov
Patricia Brogan (Wayne State University)
David Byrne (NIOSH)
John Casali (Virginia Tech University)
Steven N. Hacker (Solutia, Inc)
Lee Hager (James Anderson & Associates)
Howard Hoffman (National Institute on Deafness & Communicative Disorders/NIH)
Dan Johnson (ANSI/ISO Standards)
James E. Lankford (Northern Illinois University)
Carol Merry (NIOSH)
Anthony Miltich (Digital Hearing Systems Corporation)
Doug Ohlin (U.S. Army Center for Health Promotion and Preventative Medicine)
Scott Schneider (Laborers International Union)
Mark R. Stephenson (NIOSH)
Randy Tubbs (NIOSH)

Indoor Environment

Mark Mendell (NIOSH) mfmo@cdc.gov
Darryl Alexander (American Federation of Teachers)
William S. Cain (University of California, San Diego)
Bill Fisk (Lawrence Berkeley National Laboratory)
Caroline Freeman (Occupational Safety and Health Administration)
John Girman (Environmental Protection Agency)
Cindy Hines (NIOSH)
Paul Jensen (NIOSH)
Kathleen Kreiss (NIOSH)
Hal Levin (Building Ecology Research Group)
Don Milton (Harvard University)
Larry Rexroat (General Services Administration)
Ken Wallingford (NIOSH)

Infectious Diseases

David Weissman (NIOSH) dqw4@cdc.gov
Thomas K. Hodous (NIOSH)
James August (American Federation of State, County, and Municipal Employees)
Yvonne Boudreau (NIOSH)
Joel Breman (Fogarty International Center/NIH)
William G. Denton (Denton International)
Amanda L. Edens (Occupational Safety and Health Administration)
June Fisher (San Francisco General Hospital)
David Henderson (Office of the Director/NIH)
Janice Huy (NIOSH)

(continued inside back cover)

NATIONAL OCCUPATIONAL RESEARCH AGENDA

UPDATE 2001

NORA™

CONTENTS

Table of Contents

Message from NIOSH

Publication of this NORA Update 2001 and the celebration of our 2001 NORA Symposium mark both the midpoint of the 10-year implementation of NORA and the 30th anniversary of the establishment of NIOSH by the Occupational Safety and Health Act.

Throughout its thirty years as the nation's primary research agency for worker safety and health, NIOSH has played a vital role in improving safety and health conditions in the workplace. We track diseases and injuries efficiently, we identify risks with sophisticated techniques, we design and evaluate creative interventions, and we communicate and educate widely and rapidly. For these accomplishments, we acknowledge the scientific excellence of our predecessors, who have brought us further than we ever could have imagined thirty years ago. However, we are all too aware that much remains to be done and new challenges constantly appear. As we remember our past, we recognize that NIOSH did not come this far alone and, as we anticipate our future, we acknowledge that partnership, collaboration, and participation are the keys to success.

NORA at five years both reflects and focuses the progress of NIOSH at thirty years. NORA is the embodiment of partnership and – by targeting research – fosters a sense of community and common purpose among researchers and practitioners in the wide variety of disciplines under the banner of occupational safety and health. NORA provides a forum for diverse voices in labor, industry, government, and academia to contribute their unique perspectives. NIOSH at age thirty has a long history of listening to and addressing those perspectives, but NORA has given us a powerful mechanism to convert perspectives into data to effect real change. As in previous years, we are proud to see NORA used as a model for other organizations devising agendas for their own research and practice. You will hear from three of those organizations at the 2001 NORA Symposium.

At the midpoint of the ten-year plan, we are confident that the NORA partners can sustain this momentum through the next five years as more NORA-funded projects are completed, and more ideas are generated for research, intervention, and prevention. Please take some time to review the accomplishments reported in this document. We are happy to report that extramural funding for research progressively increased through all five years; other Federal agencies are increasingly willing to contribute to NORA projects; team documents continue to be published; new large-scale, interdisciplinary NIOSH intramural projects have been launched in NORA priority areas; and new partnerships and working groups have been formed to address emerging issues. We also are proud to report that early NORA-funded projects are now reaching maturity and that we will have an opportunity to hear about a sample of those projects for the first time at a NORA symposium. We thank all of those who took the time to submit abstracts of their work for the 2001 Symposium. Selecting from more than 180 high-quality submissions certainly was a difficult task.

Finally, we extend special congratulations to the recipients of the second NORA Partnering Award to be presented at this year's Symposium. We thank the NORA Liaison Committee for their efforts in selecting the awardees and especially thank them for five years of advice and counsel as we look forward to working with them in the next five years.

Kathleen M. Rest, Ph.D., M.P.A.
Acting Director
National Institute for Occupational Safety and Health

NIOSH Vision

Delivering on the Nation's promise: safety and health at work for all people...through research and prevention.

NORA Vision

No single organization has the resources necessary to conduct occupational safety and health research to adequately serve the needs of workers in the United States. These constraints mandate that the entire occupational safety and health community engage in collaboration and coordination of its resources. The National Institute for Occupational Safety and Health (NIOSH) and its public and private partners developed the National Occupational Research Agenda (NORA) to provide a framework to guide occupational safety and health research—for NIOSH and the entire occupational safety and health community.

Liaison Committee

Bonnie Rogers (Committee Chair)
American Association of Occupational Health Nurses

James August
American Federation of State, County, and Municipal Employees

Robin Baker
American Public Health Association

Carol Boraiko
American Chemistry Council

Thomas Bresnahan
American Society of Safety Engineers

William B. Bunn
Navistar International Transportation Corporation

Leo Carey
National Safety Council

Tai Chan
General Motors Corporation

Harry Ettinger
American Industrial Hygiene Association

William Greaves
American College of Occupational and Environmental Medicine

Tee Guidotti
Association of Occupational and Environmental Clinics

Gwendolyn Keita
American Psychological Association

Monroe Keyserling
Association of University Programs in Occupational Health and Safety

Sandra Lange
National Institute of Environmental Health Sciences/ NIH

Tom Leamon
Liberty Mutual Insurance Company

Wayne Lednar
Eastman Kodak Company

Pamela Tau Lee
Environmental Justice Committee

Joseph Main
United Mine Workers of America

Frank Mirer
United Auto Workers

Robert Pleasure
Center to Protect Workers' Rights

Beth Resnick
National Association of County and City Health Officials

Margaret Seminario
AFL-CIO

Michael A. Silverstein
Department of Labor and Industries, Washington State

Frank White
Organization Resources Counselors, Inc.

Liaison Committee Perspective

Over the past five years, the National Occupational Research Agenda (NORA) has become the model of stakeholder involvement for states, professional organizations, and our many international counterparts. They look to NORA, and to NIOSH, to understand the importance of stakeholder involvement in the development and implementation of occupational safety and health research. The NORA Liaison Committee provides stakeholder input for NIOSH and serves as a vital force for NORA stewardship. The Committee members mirror the diversity of the numerous stakeholders in the occupational safety and health community. With members from government, industry, labor, professional organizations and academia, we provide strong, broad-based representation of NORA's stakeholders.

As chair of the Committee, I am proud to report that the members have worked hard to fulfill their responsibilities for NORA. In 2000, the Committee assumed responsibility for the NORA Partnering Award for Worker Health and Safety. The Committee issued a Call for Nominations this past fall and received eight outstanding nominations. We are delighted to announce the 2001 NORA Partnering Award goes to the project "A Strategic Plan for Reducing Occupational Dermatitis in Oregon." This year, because of the high quality of the nominations, the Committee voted to also award Honorable Mention to the project "Crab Related Respiratory Illness in Dutch Harbor, Alaska." For more details on the 2001 NORA Partnering Award for Worker Health and Safety, please see page 27.

The Committee also has two subcommittees that focus on specific areas of concern. One of the subcommittees focuses on a periodic survey to determine the effectiveness and reach of NORA. The other explores ways that NIOSH can partner with other agencies and stakeholders to augment NORA funding and implementation.

On behalf of all the Committee members, we look forward to our ongoing work with NIOSH and its many partners to make sure NORA continues to change and adapt to the dynamic safety and health issues of the workplace and workforce.

Bonnie Rogers, DrPH, COHN-S, FAAN
Chair, NORA Liaison Committee
University of North Carolina, Chapel Hill

Background - An Agenda for the 21st Century

In April 1996, NIOSH and its partners unveiled the National Occupational Research Agenda (NORA), a framework to guide occupational safety and health research into the next decade - not only for NIOSH but for the entire occupational safety and health community. Approximately 500 organizations and individuals outside NIOSH provided input into the development of the Agenda. Before NORA, no national research agenda existed in the field of occupational safety and health, and no research agenda in any field had captured such broad input and consensus. The NORA process resulted in a remarkable consensus about the top 21 research priorities (see table below).

NORA Priority Research Areas

CATEGORY	PRIORITY RESEARCH AREAS
Disease and Injury	Allergic and Irritant Dermatitis Asthma and Chronic Obstructive Pulmonary Disease Fertility and Pregnancy Abnormalities Hearing Loss Infectious Diseases Low Back Disorders Musculoskeletal Disorders of the Upper Extremities Traumatic Injuries
Work Environment and Workforce	Emerging Technologies Indoor Environment Mixed Exposures Organization of Work Special Populations at Risk
Research Tools and Approaches	Cancer Research Methods Control Technology and Personal Protective Equipment Exposure Assessment Methods Health Services Research Intervention Effectiveness Research Risk Assessment Methods Social and Economic Consequences of Workplace Illness and Injury Surveillance Research Methods

NORA arose from the recognition that occupational safety and health research in both the public and private sectors would benefit from targeting limited resources. The creators of the Agenda also recognized the need to address changes in the U.S. workplace, as well as the increasingly diversified workforce. The distribution of jobs in our economy continues to shift from manufacturing to services. Longer hours, compressed work weeks, shift work, reduced job security, and part-time and temporary work are realities of the modern workplace. By the year 2008, the U.S. workforce will grow to an estimated 155 million, with minorities representing 28 percent of the workforce and with women representing 48 percent.

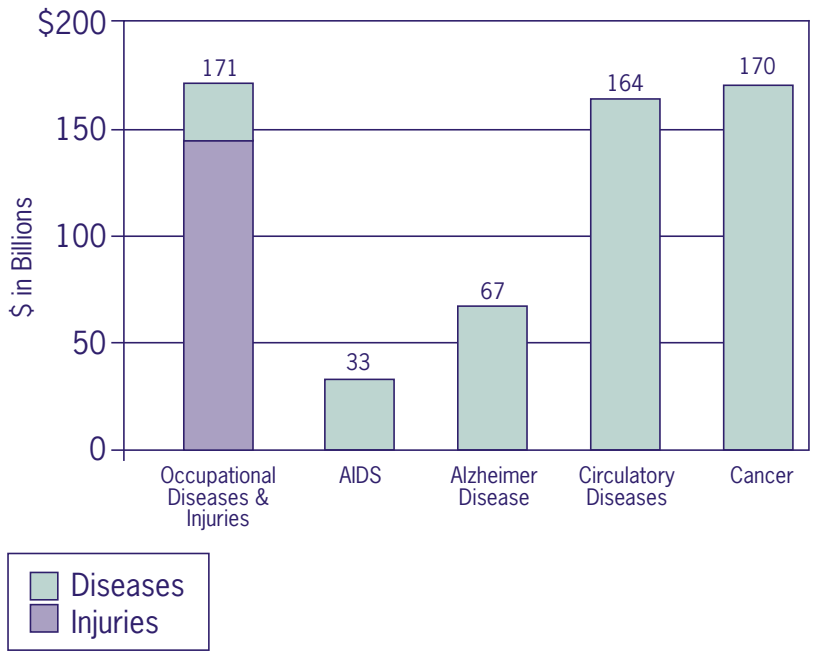
BACKGROUND

NORA addresses the broadly recognized need to focus research in the areas with the highest likelihood of reducing the still significant toll of workplace injury and illness. Each day, an average of 9,000 U.S. workers sustain disabling injuries on the job, 16 workers die from an injury sustained at work, and 137 workers die from work-related diseases. The economic burden of this continuing toll is high. Data from a NIOSH-funded study reveal $171 billion annually in direct and indirect costs of occupational injuries and illnesses ($145 billion for injuries and $26 billion for diseases). These costs compare to $33 billion for AIDS, $67.3 billion for Alzheimer's Disease, $164.3 billion for circulatory diseases, and $170.7 billion for cancer (see graph below).

Developing NORA was only the first step in the collaborative effort between NIOSH and its many partners to guide and promote occupational safety and health research. Even at the time the Agenda was announced, there was a common commitment to work to implement the Agenda, namely, to increase activities and resources in the 21 priority areas. In the first five years of NORA's implementation, NIOSH and its partners have demonstrated that NORA is generating funding and research activities in the 21 priority areas. The 20 partnership teams (the two musculoskeletal priority research areas are being addressed by one team) have been instrumental in this success.

Prior to NORA, research in occupational safety and health was fragmented, suffering from a "shotgun" approach to tackling major problems. Through NORA, the nation is better positioned to address the toll of workplace injury, illness and death.

Economic Burden of Disease and Injury *(Direct and Indirect Costs)*



Measuring the Success of NORA

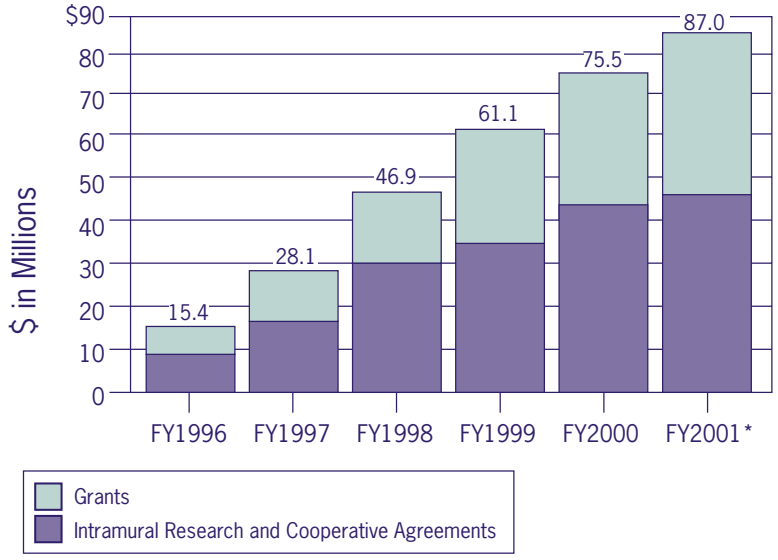
Tracking Research Funding in NORA Priority Areas

NIOSH Funding

As the only Federal agency with a mandate to conduct and fund occupational safety and health research, NIOSH made a commitment to refocus some of its resources to address the 21 NORA priority areas. Data are available to track both the number of projects and total economic resources in each priority area.

In FY 1996, at the time the Agenda was unveiled, the NIOSH baseline investment in the NORA priority areas was $15.4 million (approximately 9 percent of the FY 1996 budget). Of this, $8.7 million was devoted to intramural research (NIOSH-conducted) and cooperative agreements (NIOSH-funded extramural research in which NIOSH partners with an external party), and $6.7 million for research grants (extramural investigator-initiated projects). A refocusing of NIOSH baseline resources, as well as Congressionally appropriated funds of $35.5 million, have brought NORA to an estimated FY 2001 funding level of $87 million ($40.4 million in grants and $46.6 million in intramural research and cooperative agreements), an investment that is 34 percent of the total NIOSH budget.

NIOSH NORA Investment



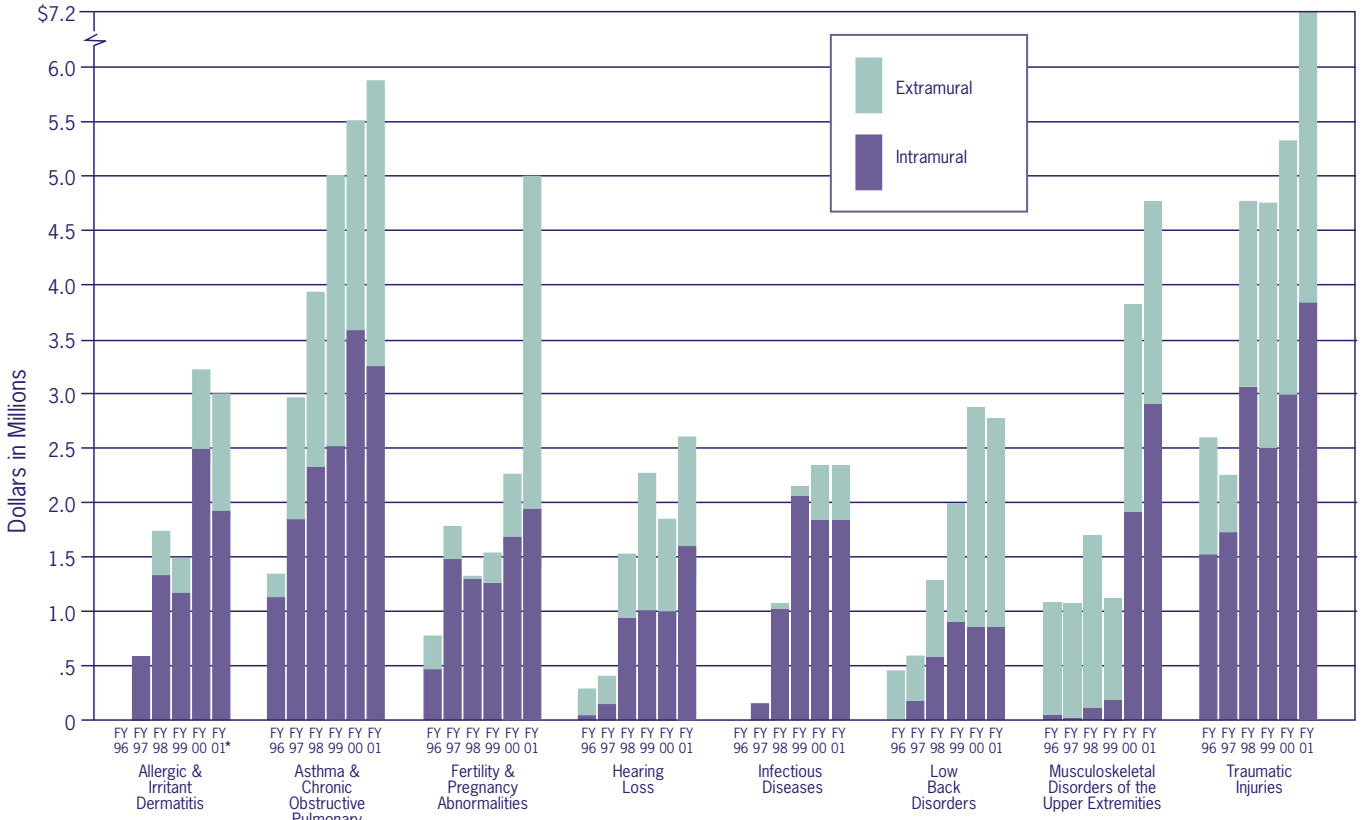
* FY 2001 numbers are estimates

The increase in total budget percentage is tangible evidence of NIOSH's commitment to NORA. This shift is particularly notable given existing Congressional mandates and obligations that limit how much of the NIOSH budget can be refocused. An ongoing effort has been in place since NORA's inception to assure that these shifts are "real" (rather than merely a reporting artifact) using consistent definitions and an independent evaluation team to assess projects for NORA-relatedness.

TRACKING

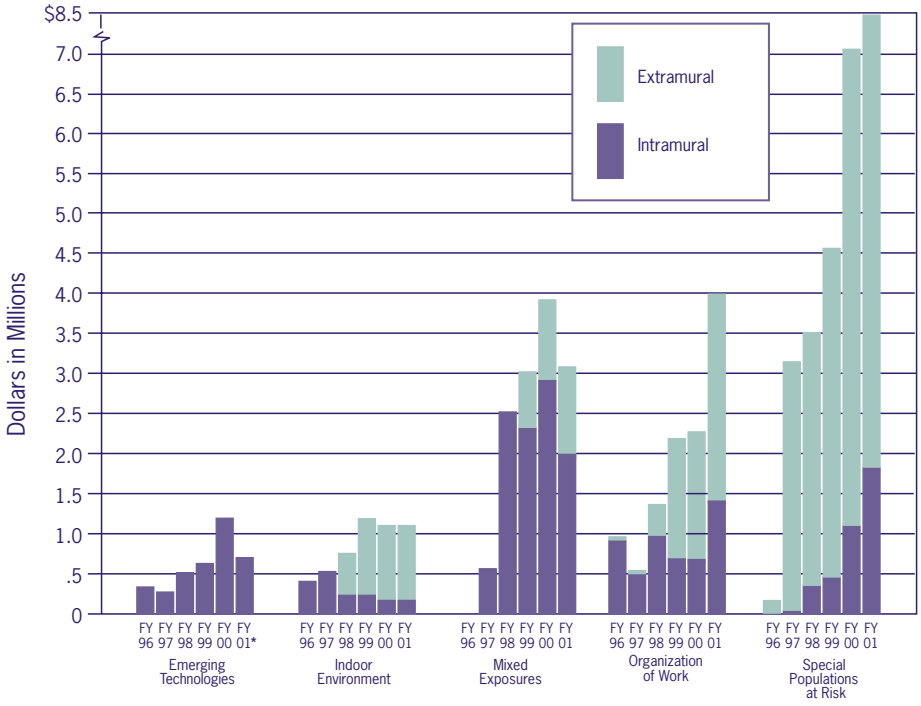
NIOSH NORA Investment by Priority Research Area, FY 96-99

Disease and Injury



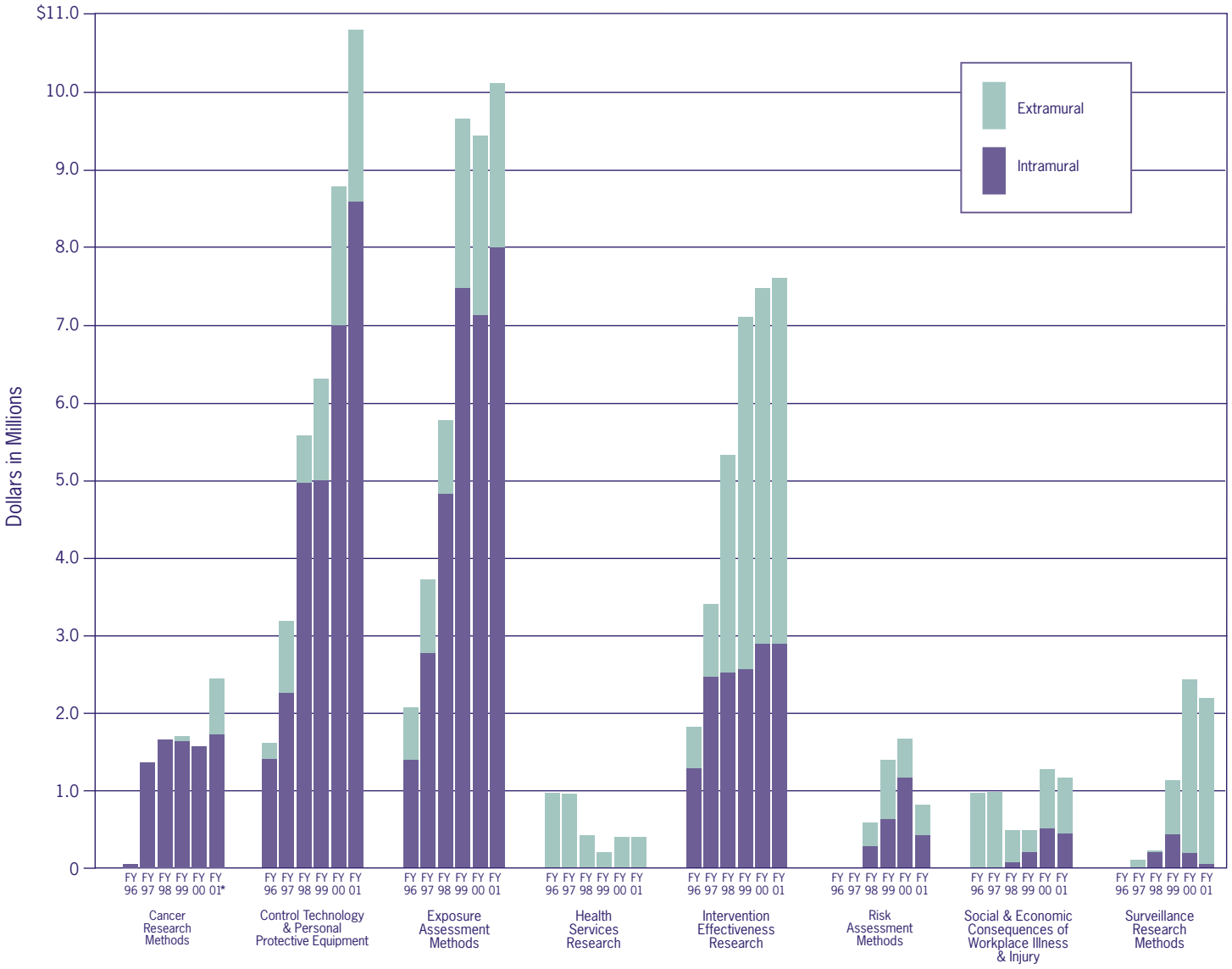
*FY 01 numbers are estimates.

Work Environment and Workforce



*FY 01 numbers are estimates.

Research Tools and Approaches



*FY 01 numbers are estimates.

TRACKING

Intramural Initiatives

NORA has helped NIOSH focus its intramural research to create large programmatic initiatives composed of interrelated and coordinated research projects targeted at high-priority occupational topics of national importance. This multidisciplinary effort, referred to as "Big NORA," has resulted in increased collaboration, intensive peer review of internal research, and integration of projects and resources.

In March 1999, NIOSH encouraged its intramural researchers to join together to compete for new FY 2000 NORA funding with large scale proposals in selected NORA priority areas. After internal review of the proposals, three programs were chosen for further development: an exposure-response and intervention program for the prevention of work-related musculoskeletal disorders; a program for development of a dermal policy based on laboratory and field studies; and a research program for occupational asthma reduction. After a two-staged external peer review process, these three programs were funded at a total level of $3.9 million.

The Big NORA effort generated considerable enthusiasm, both internally and externally, during its first year, and served as a model for large, multi disciplinary efforts that capitalize on the diverse expertise available within NIOSH. Building on the success of the FY 2000 programs, four additional Big NORA programs were funded in FY 2001, for a total of $2.8 million in new funding.

The FY 2001 initiative on hearing loss prevention covers a range of projects including hearing loss surveillance, exposure monitoring strategies, intervention effectiveness for hearing impaired workers, engineering controls, and web-based information dissemination. The component projects are tightly integrated through a program design that emphasizes information sharing between projects and use of common research protocols, populations, and work sites.

The initiative on preventing injury and illness among nurses covers such diverse topics as health effects of work schedules, violence prevention, antineoplastic drug exposure, and reproductive health. A coordination core activity provides program administration, promotes information sharing among the projects, and helps to communicate program findings to NIOSH stakeholders.

The other FY 2001 Big NORA programs focus on traumatic injury research and organizational risk factors for depression and cardiovascular disease.

NORA Research: What Counts?

NIOSH has set a high bar to determine which studies are designated as NORA research. Efforts to ensure that NIOSH does not "over count" NORA research have resulted in an actual under representation of research in the 21 priority areas. A Quality Assurance Committee of senior NIOSH scientists reviews all intramural and extramural research proposals to determine whether they indeed qualify as NORA research. To track and report funding of NORA research, NIOSH counts only studies that devote at least 80% of the research effort to a designated NORA topic. This strict definition provides a valid and consistent method of tracking NORA progress over time. Some important activities in occupational safety and health, such as surveillance programs, have research elements but may not be primarily research. Likewise, some research (e.g., an occupational cancer epidemiology study) may involve a NORA subject (e.g., cancer research methods), without the NORA subject being the primary emphasis. In addition, a project that is distributed equally between two NORA areas such as 50 percent in hearing loss and 50 percent in control technology would not be counted by this definition in either NORA area. Data are available, however, to count projects with as little as 20% dedicated to a priority area.

One example of how the high threshold NORA definition excludes important contributions to NORA research is the Fatality Assessment Control and Evaluation (FACE) Program. NIOSH and 20 state partners evaluate incidents in which workers have been fatally injured. This information is used to improve and promote the use of prevention strategies. FACE contributes importantly to the NORA Traumatic Injuries priority area, but since surveillance and education are a large component, investments in FACE are not included in the routine tracking of NORA research spending.

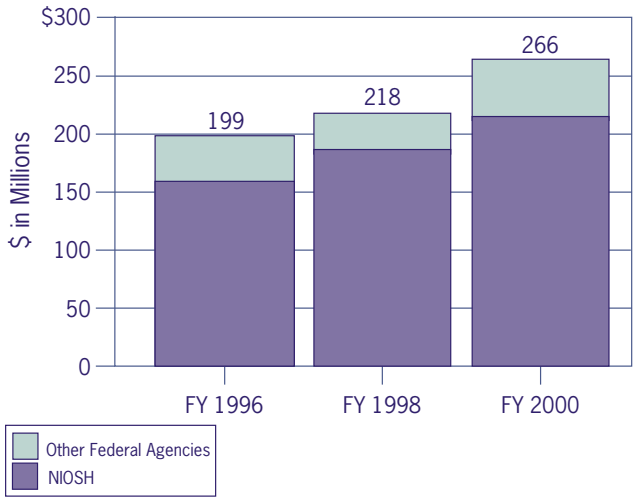
TRACKING

TRACKING

Other Federal Funding

As part of NORA, a survey of federal occupational safety and health research is conducted biennially. The first survey, covering FY 1996, provided a baseline identifying a total of only $39 million spent for all occupational safety and health research outside of NIOSH for an overall federal investment of $199 million. The FY 1998 survey identified the total spending in occupational safety and health research reported by federal agencies at $218 million, with $31 million coming from non-NIOSH federal sources. For FY 2000, federal agencies outside NIOSH reported spending $51 million in occupational safety and health research. With the NIOSH investment of $215 million, the total federal investment in occupational safety and health research reached $266 million in FY 2000.

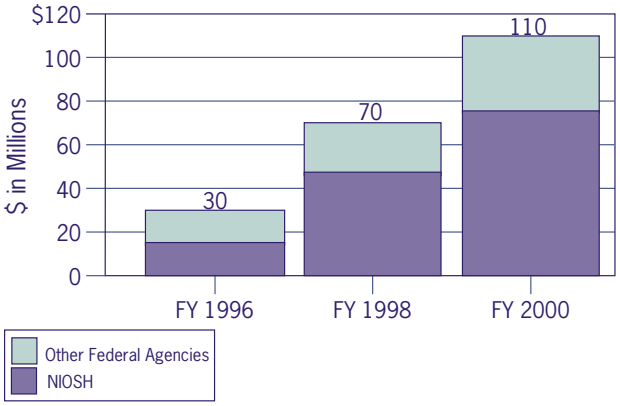
Federal OS&H Spending FY 1996, FY 1998, and FY 2000



For purposes of this analysis, the total NIOSH budget is attributed to occupational safety and health research.

The FY 1996 baseline for NORA-related research from other federal sources was $15 million, increased to $23 million in FY 1998, and to $35 million in FY 2000.

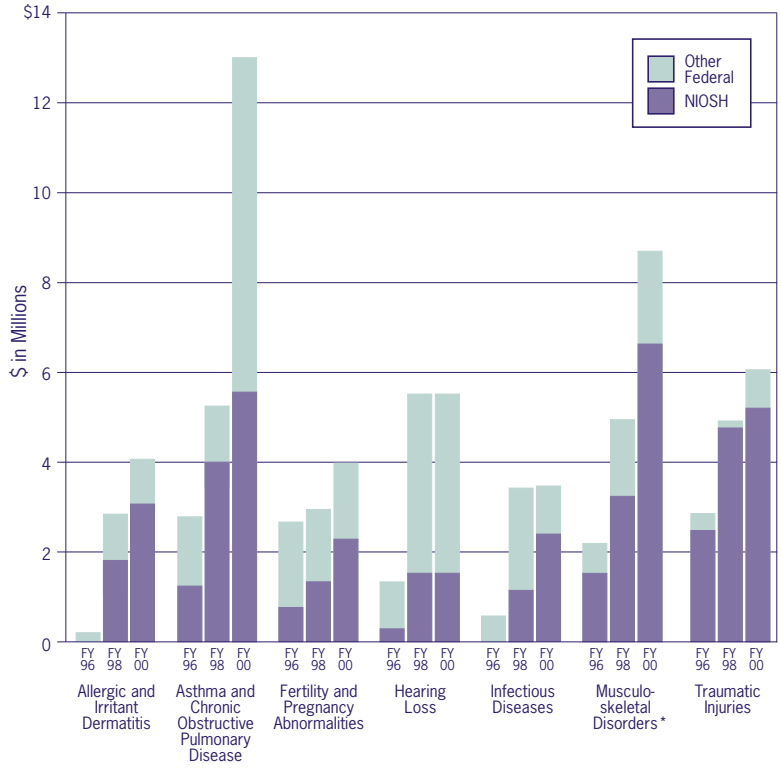
Federal NORA Spending FY 1996, FY 1998, and FY 2000



In FY 2000, unlike prior surveys, there was no report of spending by federal partners in the priority areas of Emerging Technologies or Social and Economic Consequences of Workplace Illness and Injury to fund activities that were predominantly research and focused on occupational safety and health issues. However, in FY 2000, for the first time there was spending reported by federal partners in the priority area of Indoor Environment. Ten of the twenty NORA priority research areas received increased funding by non-NIOSH federal partners in FY 2000 over FY 1998, with the largest gains in Asthma and Chronic Obstructive Pulmonary Disease. The funding remained virtually constant in five areas, and five experienced decreases. In sum, there have been increases in federal partner funding for occupational safety and health research in general, and NORA in particular, indicating more than a redirection of resources already allocated to NORA, and marking new investments in the priority areas. Federal partners will continue to perform the survey biennially, with the next survey assessing FY 2002 expenditures.

Federal NORA Spending by Priority Area

Disease and Injury

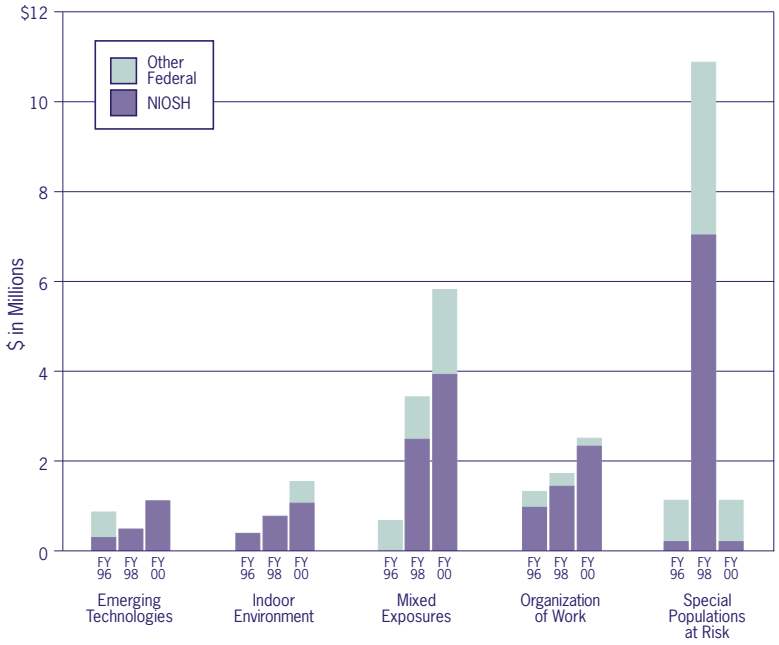


* Combines two NORA priority areas, Low Back Disorders and Musculoskeletal Disorders of the Upper Extremities

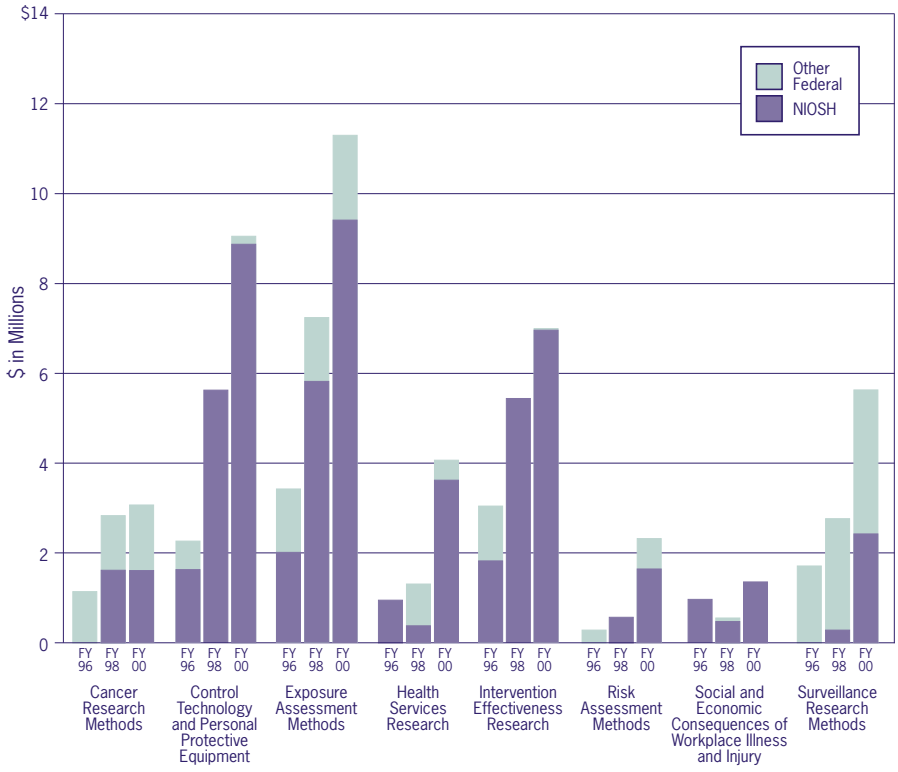
TRACKING

Federal NORA Spending by Priority Area, *continued*

Work Environment and Work Force



Research Tools and Approaches



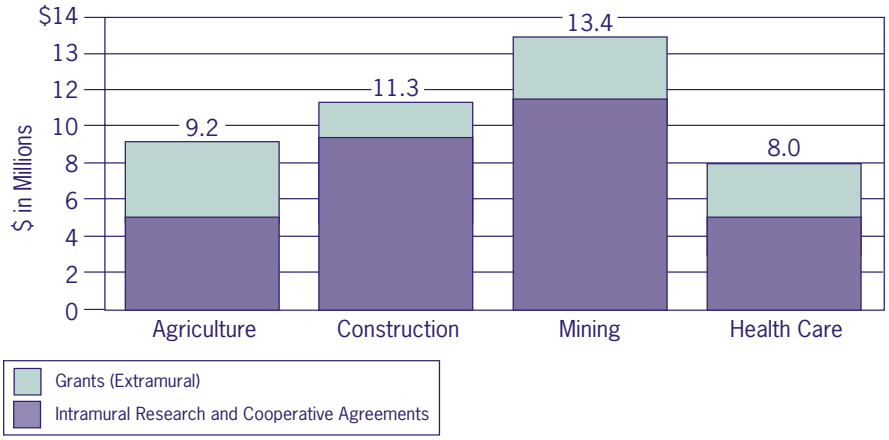
Due to the scale of this graphic the following investments are not visible:

NIOSH FY 1996	
Cancer Research Methods:	$44,000
Other Federal FY 1998	
Control Technology & PPE:	$38,000
Intervention Effectiveness Research:	$43,000

Sector-Specific Funding

To most effectively address research needs in specific sectors (such as construction, mining, agriculture, and health care), NIOSH applies a matrix approach of coordinated research in some or all of the 21 priority areas, as appropriate for each sector. As such, it is clear that NORA has increased sector-focused research. In FY 2001, over $41 million of NIOSH's $87 million investment in NORA is being allocated to NORA research in agriculture ($9.2 million), construction ($11.3 million), mining ($13.4 million), and health care ($8.0 million). These figures do not include NIOSH's non-research activities in these sectors (e.g., funding of the nine Centers for Agricultural Disease and Injury Research, Education, and Prevention, that are involved in both research and non-research activities).

NORA Investments by Sector, FY 2001 *



* FY 2001 numbers are estimates. Graph reflects investment in NORA research, not total NIOSH investment in sector.

TRACKING

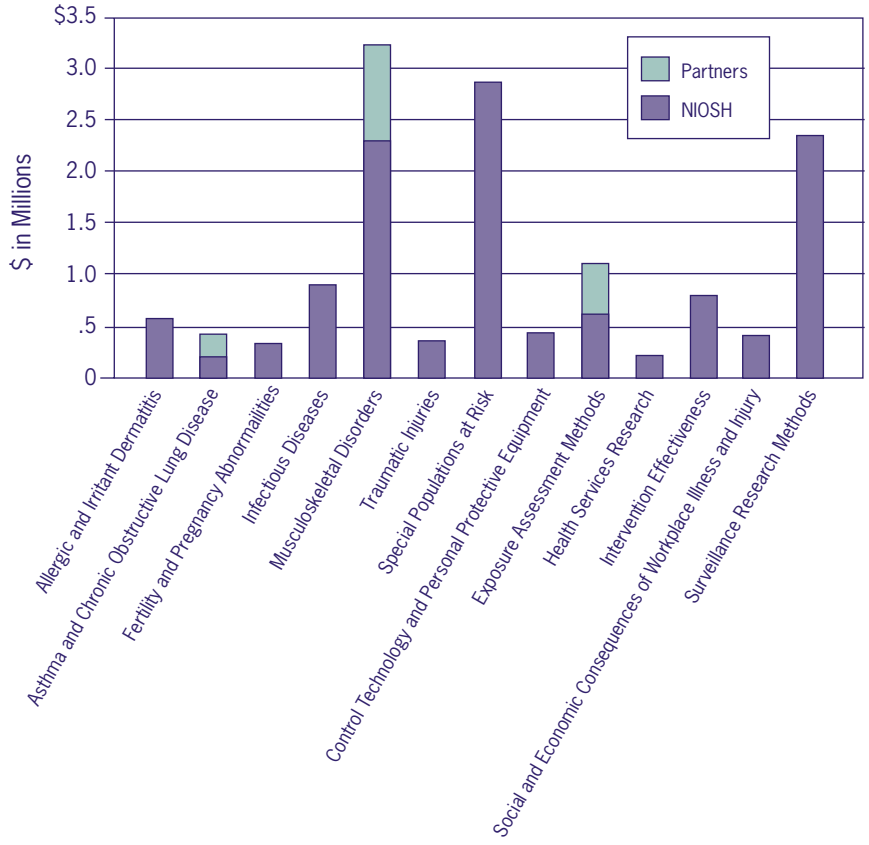
TRACKING

NORA Grant Funding

NORA has been very successful in stimulating new research needed to address the problem of workplace injuries and illnesses. A major initiative was started in FY 1998 when NIOSH and three federal partners awarded about $8 million in grants in ten NORA priority research areas, making it the largest infusion of federal government funding for extramural occupational safety and health research ever. NIOSH built on these partnerships in FY 1999 and jointly announced two targeted Requests for Applications (RFAs) with six other federal agencies.

The momentum continued in FY 2000 with nine federal partners: the National Cancer Institute (NCI); National Heart, Lung, and Blood Institute (NHLBI); National Institute on Aging (NIA); National Institute on Alcohol Abuse and Alcoholism (NIAAA); National Institute of Allergy and Infectious Diseases (NIAID); National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS); National Institute on Deafness and Other Communication Disorders (NIDCD); National Institute of Environmental Health Sciences (NIEHS); and the Environmental Protection Agency (EPA). These federal partners funded more than $6 million in areas relevant to NORA in FY 2000. NIOSH funded grants in all NORA areas totaling approximately $32.7 million in FY 2000 (an increase of $6 million from FY 1999). The figures in the graph below represent only new grants in NORA priority areas. (For a listing of the new NORA grants see pages 16-17.)

FY 2000 New NORA Grant Awards



For FY 2001, NIOSH and 15 federal partners have solicited applications in all 21 NORA priority areas under program announcements in occupational safety and health, cancer research methods, research on emergency medical services for children, and research on beryllium-induced diseases. The amount of grant funding will depend on the number of quality applications received. The other federal partners participating in NORA-related announcements in FY 2001 include NCI, NHLBI, NIA, NIAAA, NIAID, NIAMS, National Institute of Child Health and Human Development (NICHHD), NIDCD, National Institute on Drug Abuse, (NIDA), NIEHS, National Institute of Mental Health (NIMH), and the National Institute of Nursing Research (NINR) within the NIH; the Health Resources and Services Administration (HRSA) and the Agency for Healthcare Research and Quality (AHRQ) within the Department of Health and Human Services; and the Department of Energy (DOE).

In addition to the program announcements, NIOSH and three co-sponsors (NCI, NIEHS, and the Environmental Protection Agency) announced $6 million for research related to endocrine disruptors. NIOSH also announced $3.6 million for three additional RFAs that target the NORA-related areas of:

- Reducing occupational injuries in the workplace;
- Examining relationships between overtime, long hours of work, or demanding work schedules, and risks to worker safety or health, including injuries, musculoskeletal and cardiovascular diseases, and stress; and
- Increasing the understanding of the relationship between exposures to workplace chemicals and problems with reproduction or development.

TRACKING

TRACKING

FY 2000 NORA Grant Awards

This listing includes 59 new NORA grants funded by NIOSH in FY 2000. In addition, NIOSH is supporting 106 continuing grants, for a total of 165 NORA awards.

Allergic and Irritant Dermatitis

Assessing Latex Avoidance on Occupational Sensitization
Johns Hopkins University

Confocal Histopathology of Contact Dermatitis In Vivo
Massachusetts General Hospital

Dermal Absorption of Cutting Fluid Mixtures
North Carolina State University

Asthma and Chronic Obstructive Pulmonary Disease

Initial Respiratory Responses in Welding Apprentices
University of Massachusetts

Control Technology and Personal Protective Equipment

A Device for Eliminating Electrocutions by Mobile Cranes
Technological Systems Research

Permeation of Irritant Mixtures Through Protective Materials
University of California

Exposure Assessment Methods

Making Heat Stress Assessment Relevant Again
University of South Florida

RF Exposure and Melatonin Levels in Heat-Sealer Workers
University of Washington

Statistical Problems in Occupational Safety and Health
University of Maryland

Fertility and Pregnancy Abnormalities

Male Subfertility by Ni_2^+ Poisoning of Ca_2^+ Channels?
North Shore University Hospital

Serum Inhibin B Levels in Male Polymer Production Workers
University of Louisville Research Foundation, Inc.

Ubiquitin-Based Semen Quality Assay in Toxicology
Oregon Health Sciences University

Health Services Research

Outcomes of Injured Employee Health Status Assessment
University of Vermont and State Agricultural College

Social Inequalities in Occupational Health and Health Services
University of Massachusetts

Infectious Diseases

BBP Exposure and Risk Factors in Non-Hospital Based HCWs
Columbia University

Bloodborne Exposure Management
Columbia University

Exposure to Blood Among Non-Hospital Health Care Workers
Analytical Sciences, Inc.

Intervention Effectiveness Research

Effectiveness of Computer-Based Hearing Test & Training
University of Michigan

Effects of an Ergonomic Intervention for Computer Work
University of California

Effectiveness of Interventions for Customer Service Work
University of California

Evaluation of Exposure Control in the Autobody Industry
Tulane University

Workers' Compensation Internet Low Back Pain Study
Stanford University

Low Back Disorders

Ergonomic Assessment of Vineyard Systems
University of California

Identifying Safe Load Moment Exposures for the Back
Ohio State University

Low Back Pain In Cyclic and Prolonged Occupational Activities
Louisiana State University

Low Back Pain: Physical and Psychosocial Job Factors
University of California

Spine Loading and Muscle Overexertion During Repetitive Lifting
Ohio State University

Musculoskeletal Disorders of the Upper Extremities

Exposure Response Relationship in Hand Arm Vibration
University of Connecticut

Force-Repetition Interaction in a Rat Injury Model of C.T.D.
Temple University

Prospective Study of Upper Extremity Musculoskeletal Disorders
Washington State Department of Labor & Industries

Social and Economic Consequences of Workplace Illness and Injury

Job-Related Arthritis and Disability in Retirement
University of California

Occupational Fatality Trends: A Contextual Analysis
University of North Carolina

SSDI Benefit Impacts of Occupational Injuries/Illnesses
Johns Hopkins University

Special Populations at Risk

Adapting North American Guidelines for Children's Agricultural Tasks (NAGCAT) for Ethnic Communities: A Research Model
University of Minnesota

Aging Effects on Intermittent Work Capacity
Virginia Polytechnic Institute and State University

An Evaluation of the NAGCAT
Eastern Washington University

Evaluation of NAGCAT Using Case Series of Injuries
Marshfield Medical Research & Education Foundation

Evaluation of a School-Based Agricultural Health and Safety Curriculum
Minnesota Department of Health

Evaluating Teen Farmworker Education
University of California

Health Disparities Among Health Workers
University of Massachusetts

Occupational Lead Exposure: Risk to the Aging Worker
University of Pittsburgh

Safety of Youth Employment: A National Study of Parents and Teens
University of North Carolina

Teaching Kids Safety on the Farm: What Works
Mary Imogene Basset Hospital

Using the ASHBMP Manual as a Tool to Reduce Farm Hazards
Pennsylvania State University

Surveillance Research Methods

Childhood Agricultural Trauma Evaluation System
Minnesota Department of Health

Evaluation of a Statewide Emergency Department Injury Surveillance System for Occupational Injury
Massachusetts Department of Public Health

Evaluation of a Surveillance Radiograph Standards Set
University of Washington

Improving Data Quality in Pesticide Illness Surveillance
Washington State Department of Health

Linking Occupational Injury and Illness Data Bases
Michigan State University

Model Occupational Dermatitis Surveillance/ Interventions
Oregon Health Division

Occupational Health Surveillance of Low Income, Minority Populations through Community Health Centers
Massachusetts Department of Public Health

Partnerships in Surveillance and Prevention
Oregon Health Sciences University

Pesticide Training for Adolescent Migrant Farmworkers
Oregon Health Sciences University

RRIS II: Agricultural Injury Surveillance
University of Minnesota

Surveillance of Work-Related Carpal Tunnel Syndrome
California Department of Health Services

The Youth Employment Training Pilot Program
State of Wisconsin

Worker and Worksite Factors in DIA Construction Injury
University of Colorado

Traumatic Injuries

A New Method for Yield Pillar Design to Control Coal Bumps
West Virginia University

Occupational Injuries Among Commercial Fishers
University of North Carolina

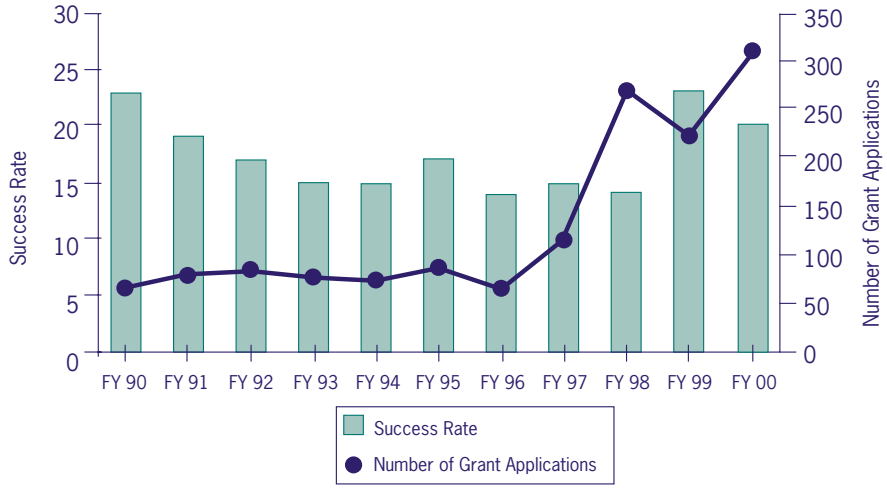
TRACKING

TRACKING

Grant Funding Success

The success of NORA in attracting research talent to occupational safety and health continues to outstrip the ability of NIOSH to fund highly-rated research proposals. The NIOSH success rate for grants funding (the percentage of qualified research proposals that are funded) still lags substantially behind the rate at NIH (20 percent vs. 32 percent in FY 2000). One consequence of a disparately low success rate is a loss of interested investigators to research fields with a higher probability of funding. Through NORA, NIOSH has worked hard to generate enthusiasm among the research community despite low success rates, and has experienced a dramatic increase in submitted and approved grants, particularly in NORA priority areas.

NIOSH Grant Funding Success, FY 1990 - FY 2000



Shifting the Balance

Another NORA success has been in shifting the spectrum of occupational safety and health research to achieve more balance between etiologic research, i.e., problem identification and characterization, and problem-solving research. Highlighting this trend is the growth of NIOSH's investment in intervention effectiveness and control technology research, which has increased from $3.4 million in FY 1996 to $16.2 million in FY 2000.

Current intervention research and control technology grants address many subjects of high concern among the general public and policy makers. These include projects that are evaluating:

- Training in lifting techniques to prevent back injuries
- Preventing hearing loss among construction workers
- Preventing silica exposure among construction workers
- A joint strategy by OSHA and the construction industry to prevent fatalities, injuries, and illness among home builders
- Reducing musculoskeletal disorders and traumatic injuries among dairy and vegetable produce farmers
- Preventing back and shoulder injuries among nursing home workers
- Ergonomic interventions to reduce musculoskeletal disorders among office workers
- Developing a device to prevent electrocutions from mobile cranes
- Designing and testing rollover protection systems for agricultural tractors

These studies provide crucial information to employers, workers, and others on the effectiveness of specific strategies for the prevention of injury and illness. For example, a recent NIOSH-funded evaluation of the effectiveness of "zero-lifting" patient transfer programs documented great reductions in injuries, lost workdays, and workers' compensation costs. For more information on this study, see below.

Grant Research Accomplishments

NORA has allowed NIOSH to diversify its research portfolio to fund research on the myriad occupational safety and health issues affecting workers. The following examples highlight the FY 2000 research accomplishments made by some NIOSH-funded investigators in NORA priority research areas.

Identification of Risk Factors for Noise-Induced Hearing Loss

Despite the implementation of hearing conservation programs in many industries, noise-induced hearing loss continues to be one of the most prevalent occupational disorders. With NIOSH support, Dr. Peter Rabinowitz and associates at the Yale School of Medicine's Occupational and Environmental Medicine Program investigated risk factors in several noisy factories. Preliminary findings indicate that hearing protection devices currently used in many hearing conservation programs may actually provide much less noise attenuation than their stated noise reduction rating. Improper fitting may account for much of this discrepancy. For example, the study suggests that in recent immigrants the level of English language skill was a strong predictor of hearing protector fit adequacy. Workers with low English skills reported greater perceived barriers to correctly using the hearing protection devices. The study suggests that individuals display a wide variability in susceptibility to noise-induced hearing loss. Some of this variability may be due to differences in antioxidant status as preliminary findings suggest that certain antioxidant deficiencies may predispose individuals to noise-induced hearing loss. The results of this study will facilitate the implementation of effective hearing loss protection programs.

Adult Asthma as a Predictor of Work Loss and Disability

Asthma is a common health problem among working adults. Asthma can interfere with daily activities and can be associated with increased risk of disability and decreased work productivity. In approximately one in ten adult asthma sufferers, an occupational component is likely to be associated with triggering the disease or its symptoms. With NIOSH funding, Dr. Paul Blanc and his collaborators at the University of California, San Francisco, studied a large group of adults with asthma to identify the factors contributing to work disability among those with this condition. They found that work disability is common for those with adult asthma, occurring to some degree in nearly one in five asthma sufferers. Those with poorer working conditions, including physical demands and chemical exposures, are about three times as likely to experience such disability, according to Dr. Blanc's research.

Effectiveness of the "Zero-Lift Patient Transfer Program"

Lifting and transferring patients is a major cause of back injuries among nurses. With NIOSH funding, Dr. Arun Garg at the University of Wisconsin, Milwaukee, evaluated the effectiveness of the "Zero-Lift Patient Transfer Program" in reducing low back disorders in seven nursing homes and one hospital. The "zero-lift" programs were implemented by replacing manual lifting and transferring of patients, with modern battery-operated, portable hoists and other patient transfer assistive devices. Injury statistics were collected during post-intervention for 51 months (range = 36-60 months) and were

TRACKING

compared with pre-intervention data for 37 months (range = 30-54 months), Overall, the eight facilities experienced decreased of 32% in all injuries, 62% in all lost workdays, 6% in all restricted workdays, and 55% in total workers' compensation costs. The nursing personnel perceived that their backs were less sore, and they were less tired at the end of their shifts. In addition, more pregnant and older workers could perform their regular duties and stay on the job longer.

Tracking Team Products

Partnership teams are an integral part of implementation and team products are being tracked as a measure of NORA's success. The teams have been very active and as expected, each is proceeding somewhat differently. Many teams are writing white papers - documents that use variable approaches to advance issues in each priority area, such as summarizing the research in a priority area, defining gaps, and identifying opportunities for collaboration. The following 17 NORA teams (covering 18 priority areas) have completed or are currently working on white papers:

- Allergic and Irritant Dermatitis
- Asthma and Chronic Obstructive Pulmonary Disease
- Cancer Research Methods
- Emerging Technologies
- Exposure Assessment Methods
- Fertility and Pregnancy Abnormalities
- Health Services Research
- Hearing Loss
- Indoor Environment
- Infectious Disease
- Intervention Effectiveness Research
- Mixed Exposures
- Musculoskeletal Disorders
- Organization of Work
- Social and Economic Consequences of Workplace Illness and Injury
- Surveillance Research Methods
- Traumatic Injuries

Partnership team activity can also be measured through conferences and workshops. From September 1996 through October 2001, NIOSH and its partners will have sponsored 51 major meetings related to NORA as a whole or to specific priority areas (one in 1996, four in 1997, ten in 1998, 12 in 1999, 20 in 2000 and four scheduled through October 2001). In addition to white papers, conferences, and workshops, teams are also developing surveys, establishing graduate-level training programs, participating in continuing medical education workshops, and developing other documents.

NORA Meetings, September 1996 through October 2001

Workplace-Related Skin Diseases and Exposure Assessment Workshop: September 25-26, 1996

Pneumonitis in the Machining Environment Workshop: January 28-29, 1997

Delaware Valley Latex Allergy Conference: March 31-April 1, 1997

First National Occupational Research Agenda Symposium: July 1, 1997

National Occupational Injury Research Symposium: October 15-17, 1997

1998 Applied Workshop on Occupational and Environmental Exposure Assessment: February 23-25, 1998

Control of Workplace Hazards for the 21st Century: March 10-12, 1998

Three Musculoskeletal Meetings to Set a Research Agenda
- March 25, 1998 – Chicago, IL
- April 20, 1998 – Seattle, WA
- April 27, 1998 – Washington, DC

Round Table Discussion on the Organization of Work at the Society for Industrial and Organizational Psychology Conference: April 24-26, 1998

Occupational Asthma: In and Out of the Workplace: April 30-May 2, 1998

Natural Rubber/Latex Allergy: Recognition, Treatment, and Prevention, Satellite Downlink Teleconference: May 5, 1998

Hazardous Substances and Male Reproductive Health: May 14-15, 1998

Research Workshop on the Risk and Benefits of Exposure to Ultraviolet Radiation and Tanning: September 16-18, 1998

Developing a National Occupational Research Agenda for Prevention of Musculoskeletal Disorders: March 8, 1999

Musculoskeletal Meeting to Set a Research Agenda (Houston, TX – fourth in a series): March 8, 1999

Work, Stress, and Health 99: Organization of Work in a Global Economy: March 11-13, 1999

Organizational Risk Factors of Illness and Injury at Work: May 9-10, 1999

NORA Symposium 1999: Partnership for Research: May 14, 1999

Experimental Contact Dermatitis Research Group Meeting: May 21-22, 1999

Functional, Economic, and Social Outcomes of Occupational Injuries and Illnesses: Integrating Social, Economic, and Health Services Research: June 13-15, 1999

The Role of Human Exposure Assessment in the Prevention of Environmental Disease: September 22-24, 1999

ATS Ad Hoc Committee on the Occupational Contribution to the Burden of Airway Disease: September 27, 1999

Occupational Exposure Databases and Their Application for the Next Published Proceedings: October 3 - November 3, 1999

Working Conditions and Quality of Care: October 12-13, 1999

Best Practices in Hearing Loss Prevention: October 29, 1999

Donald J. Birmingham Occupational Skin Diseases Session at the 11th Annual Meeting of the American Contact Dermatitis Society Annual Meeting: March 9, 2000

Preconference Workshop, NORA Musculoskeletal (MSD) Team: March 13, 2000

Third Annual Applied Ergonomics Conference: March 14-16, 2000

Preventing Hearing Loss in the Construction Trades: A Best Practices Conference: March 30-31, 2000

Workplace Violence Intervention Research Workshop: April 5-7, 2000

Continued next page

TRACKING

TRACKING

***NORA Meetings**, continued*

Workshop on Intervention Effectiveness Research at the American Occupational Health Conference: May 2000

Third International Conference on Measuring the Burden of Injury: May 15-16, 2000

Occupational Infectious Disease Research Needs – American Occupational Health Conference: May 18, 2000

Work, Smoking and Health Workshop: June 15-16, 2000

RESNA 2000 (Rehabilitation Engineering and Assistive Technology Society of North America): July 28, 2000

Future Research for Improving Risk Assessment Methods: August 15-18, 2000

Antineoplastic Drugs – Safe Handling: September 14, 2000

Human Assistive Technologies and Automation: September 14, 2000

Novel Methods of Bioaerosol Assessment Workshop: September 14-15, 2000

Workshop on Chemical Mixtures: September 21-22, 2000

National Occupational Research Injury Symposium 2000: October 17-19, 2000

Enhancing Working Conditions and Patient Safety: Best Practices: October 25, 2000

Comparing and Contrasting Reproductive Toxicity Testing for Males and Females: November 8-10, 2000

Contact Dermatitis 2000 – Blending Science with Best Practice: November 17-19, 2000

Antineoplastic Drugs – Safe Handling Working Group Meeting: December 13, 2000

Human Systems 2001: June 20-22, 2001

NORA Symposium 2001: Leading Research in Occupational Safety and Health: June 27, 2001

Best Practices in Workplace Surveillance: Identification and Tracking of Workplace Injury, Illness, Exposures, and Hazards: September 17-19, 2001

Occupational and Environmental Influences on Prematurity: October 2-3, 2001

Other NORA Tracking

NORA Effectiveness Survey

Measuring the amount of money allocated to NORA priority research areas is only one way to gauge NORA's effectiveness. The NORA Liaison Committee has administered a survey to key associations and professional organizations (see page 28). The survey will be administered periodically by the Liaison Committee to gauge the recognition and influence of NORA over time. The results of the next survey will be announced at the 2003 NORA Symposium.

Information Dissemination

NIOSH tracks visitor sessions (a measure of the number of unique users who visited a web site during a certain time period) and hits (the number of files requested from a server) on the NORA website to assess use of the web as a NORA information source. In the year 2000, the NORA website had, on average, over 5,000 visitor sessions and over 13,000 hits per month. The NORA website www.cdc.gov/niosh/norhmpg.html contains NORA documents, white papers, research summaries, NORA grants information, a calendar of upcoming everts, and partnership team information.

Many teams are using the NORA website to enhance their communication efforts. In addition, some teams have established listervs. Registered members for each listserv receive periodic emails about the work of a particular team.

NORA News, a newsletter distributed by mail and posted on the website, keeps interested parties informed about NORA's progress and activities. Reader responses to the recent *NORA News* survey were positive, with many readers saying it was their primary source for NORA information.

TRACKING

PARTNERSHIP

Partnership

NORA Partnerships

NORA has helped establish a new way of doing business at NIOSH. Although the transformation to the "new NIOSH" was in progress prior to NORA, the development and implementation of the Agenda have proven to many in the private sector that collaboration with the government is not only possible, but worthwhile.

All of the following success stories demonstrate the benefits of partnership for improving worker safety and health. In each partnership, NIOSH and other researchers share scientific expertise and creative problem-solving skills and the partners provide the "laboratories" for evaluating interventions in real work settings.

Wal-Mart

In partnership with Wal-Mart, NIOSH has completed the most definitive research study to date on the efficacy of back-supporting belts in preventing first and recurrent low back injuries. Approximately 9,000 retail merchandise employees at 160 stores in 30 states were followed for two years to determine if low back injury rates in individuals wearing belts were different from rates in individuals not wearing belts. NIOSH published the first of several analyses in a December 6, 2000 article in the *Journal of the American Medical Association.* The study found that frequent belt use did not significantly reduce back injury claims or reported low back pain. The release of this study received extensive media coverage including a nationally broadcast report on CBS Evening News, an article in USA Today, and an Associated Press article that ran in approximately 400 newspapers across the country, including the *Washington Post* and the *New York Times.*

BJC Health System

Back and other musculoskeletal injuries are among the most common injuries experienced by nursing home employees. BJC Health System designed and implemented a "best practices" back injury prevention program, and approached NIOSH for help with the scientific evaluation of the program. NIOSH and BJC are in the final phases of evaluating the efficacy of the "best practices" program for reducing the incidence and cost of back injury among nursing home workers in five nursing homes in Missouri and Illinois. The "best practices" program includes state of the art lifting equipment, training in lifting techniques, and medical management of injured workers.

BJC Health System and Liberty Mutual Research Center for Safety and Health

Slip, trip, and fall (STF) injuries are a common source of acute traumatic injury among health care workers. Researchers at NIOSH and the Liberty Mutual Research Center for Safety and Health are working with partners at BJC Health System to develop, implement, and evaluate a STF prevention program in two hospitals. A case-crossover method will be used to interview injured workers to identify specific risk factors for STF incidents. A laboratory study will assist in identifying countermeasures by examining the slip-resistance characteristics of shoes for hospital workers, samples of hospital flooring, and floor treatments. A field study in two hospitals will introduce a STF prevention program consisting of slip-resistant shoes, aggressive housekeeping, and other countermeasures, and will evaluate the program for its impact on reducing the frequency, severity, and cost of STF injuries.

Asphalt Partnership

In order to reduce worker exposure to asphalt fumes during paving operations, NIOSH formed a collaborative partnership with government, industry, and labor. The partnership developed a comprehensive engineering control strategy to reduce exposures to asphalt fumes during paving operations. The engineering control is a ventilation system attached to the paver that reduces fume and heat before they can reach the worker. Consequently, as of July 1, 1997, all highway paving machines now have this effective control technology. This very successful program was a finalist in the prestigious Innovations in American Government Award Program in 1998 and the first NORA Partnership Award in 1999. In 2001, Dr. Linda Rosenstock, former Director of NIOSH, received the National Asphalt Pavement Association's (NAPA) "Partnership for Progress" Award.

Diesel Research Partnership

Based on the success of the asphalt partnership, the United Mine Workers of America, the Bituminous Coal Operators' Association, the National Mining Association, and NIOSH have formed multiple partnerships to reduce miners' diesel exposure despite the continuing debate about miners' exposure to and health effects from diesel particulate matter. In spite of continuing scientific and regulatory controversy, both labor representatives and mine operators agreed that some action should be taken to reduce or eliminate the exposures. The partners have launched mutiple research and intervention activities to quickly arrive at their shared goal. The partners have procured the equipment needed for research including an engine dynamometer used to establish both mobile and stationary diesel test stands, that are central to the laboratory and in-mine research components. A contract was awarded to Penn State University to conduct the laboratory evaluation of the control technologies to be tested. A significant accomplishment has been the publication of a detailed report on "state-of-the-art" methods for the control of diesel emissions.

Department of Veteran Affairs

The Veterans Health Administration (VHA), within the Department of Veterans Affairs (DVA), employs one of the largest groups of healthcare workers in the U.S. There were 223,602 employees in the VHA as of November 1997. In October 1998, a Memorandum of Understanding (MOU) was signed by NIOSH and the VHA to formally establish a research partnership. The unique partnership combines NIOSH's research capabilities and DVA's large health care organization. The work will ultimately lead to a better understanding of prevention interventions for health care workers. Initially the partnership is supporting a joint study on latex allergy that will provide NIOSH with new insights into developing more effective recommendations to protect workers. The partnership has also sponsored joint participation in an Expert Meeting on Working Conditions and Quality of Care (examining the relationship between healthcare workers' health and safety and quality of patient care) as well as the conference, Enhancing Working Conditions and Patient Safety: Best Practices (exploring interventions to improve both worker and patient safety) in October 2000. NIOSH and VHA researchers are collaborating on projects related to violence among health care workers; needlestick prevention; slips, trips and falls; and hours of work. The effectiveness of preventive intervention activities will also be studied. The partnership directly relates to a number of NORA priority areas, including Traumatic Injury, Organization of Work, Asthma and COPD, Allergic and Irritant Dermatitis, Intervention Effectiveness Research, and Special Populations at Risk.

PARTNERSHIP

PARTNERSHIP

Maritime Industries

NIOSH has joined with several organizations in the ship building, repair, and dismantling/recycling industries to identify hazardous work processes, and develop ergonomic interventions aimed at reducing the number and severity of injuries, lowering workers' compensation costs, and improving work quality. Several high risk processes, jobs, and tasks have already been identified at the shipyards, and ergonomic interventions are being evaluated. Included in the partnership are some of the largest domestic shipyards represented by the National Shipbuilding Research Program Advanced Shipbuilding Enterprise, several smaller yards represented by the Shipbuilders' Council of America, and a public yard operated by the U.S. Navy. These shipyards are widely distributed in size and location, and include both union and non-union operations and military and commercial vessels. Among the cooperating unions are the International Brotherhood of Electrical Workers, several local Metal Trades Councils, and the International Brotherhood of Boilermakers. Other participating Federal agencies include the U.S. Navy and Coast Guard as end-users, and the OSHA Standards Development and Maritime Divisions all of which are interested in industry-specific ergonomic best practices guidelines, the anticipated end-product from this project.

NORA - A Model for Partnership

One of the most encouraging testaments to the success of NORA is the number of other organizations using NORA as a model for creating research agendas or other types of partnership and planning. NORA has generated tremendous interest – especially at the federal level – because of its innovative approach to strategic planning. NIOSH has shared its experience with many who have sought to undertake a similar effort. Examples of such planning efforts follow.

International and Foreign National Organizations

- European Agency for Safety and Health at Work
- Istituto Superiore Per La Prevenzione E La S Curezza Del Lavoro (the Italian Institute for Occupational Safety and Health)
- Japanese National Institute of Industrial Health
- Norwegian National Institute of Occupational Health

Federal Agencies and Programs

- Department of Defense, Deployment Toxicology Research and Development Master Plan
- Environmental Protection Agency, Human Health Indoors Project
- Chemical Safety and Hazard Investigation Board
- National Committee on Vital and Health Statistics
- Centers for Disease Control and Prevention
- Agency for Toxic Substances and Disease Registry

State Agencies Conducting Occupational Health Research

- Maine
- California
- Washington

Non-Profit Research Organizations

- The Pacific Northwest Agricultural Safety and Health Center, Occupational Research Agenda for Northwest Farming
- The Chemical Industry Institute of Toxicology

NORA Partnering Award

NIOSH presented the first Partnering Award for Worker Health and Safety at the 1999 NORA Symposium. This award honors exemplary teamwork, innovative thinking, and strong science in the interest of worker safety and health. It was created to recognize those organizations participating in NORA-related collaborative research partnerships that result in the development of new equipment, practices, products, procedures, or policies that reduce hazardous exposures and/or adverse outcomes in order to protect worker health and safety.

The Asphalt Partnership received the first NORA Partnering Award for its unique collaboration. The partnership brought together diverse organizations to reduce workers' exposure to asphalt fumes during highway paving. The partners included the Asphalt Institute, Federal Highway Administration, International Union of Operating Engineers, Laborers' Health and Safety Fund of North America, Laborers' International Union of North America, National Asphalt Pavement Association, NIOSH, and the Occupational Safety and Health Administration.

In 2000, the NORA Liaison Committee assumed responsibility for the NORA Partnering Award, including solicitation of nominations and selection of the award winner. For the 2001 Partnering Award, the Committee received eight outstanding nominations, which resulted in a competitive pool of partnership projects. Liaison Committee volunteers, including representatives from labor, industry, a professional association, and academia, formed a subcommittee to evaluate the nominations and select this year's winner. The recommendations of the subcommittee were then placed before the entire Committee for approval.

For 2001, the winning partnership project is "A Strategic Plan for Reducing Occupational Dermatitis in Oregon." This project was initiated by the Oregon State Department of Human Services, Health Division following pilot projects demonstrating significant underreporting of occupational dermatitis based on analysis of lost-worktime only claims. Through a public-private partnership that started with the active participation of worker compensation carriers to permit better disease tracking for targeted prevention efforts, the project identified plant-induced dermatitis in the agriculture and forestry industry and latex glove-related dermatitis in non-health care workers. Based on this information, broad coalitions were built to put data to use for prevention. Partners in this award in addition to the Oregon State Health Division include the Liberty Mutual Northwest Insurance Company; Columbia Helicopters, Inc.; the Oregon Restaurant Association; the United Food and Commercial Workers Union, Local 555; Enviroderm Pharmaceuticals, Inc.; and environmental services personnel from five county health departments. Intensive outreach efforts aimed at product substitution and personal protection have resulted in significant declines in the incidence of medical claims for occupational dermatitis in logging, and in the elimination of the use of latex gloves in many restaurants. Similar efforts are now underway targeting child care centers, retail grocery stores, and other workplaces.

Due to the high quality of nominations received for the 2001 Partnering Award, the Liaison Committee voted to award Honorable Mention for one of the partnership projects. The NORA 2001 Partnering Honorable Mention goes to the project, "Crab Related Respiratory Illness in Dutch Harbor, Alaska." Partners involved in this investigation of respiratory illness in crab processing workers include UniSea management, UniSea workers, and NIOSH.

The 2001 Partnering Award will be presented at the NORA Symposium 2001: Leading Research in Occupational Safety and Health on June 27 in Washington, DC.

Guiding NORA Implementation

Liaison Committee

The NORA Liaison Committee, chaired by Dr. Bonnie Rogers (Past President, American Association of Occupational Health Nurses), consists of 24 members representing industry, labor, academia, professional organizations, and government (see listing on page 2). The Liaison Committee's role is to provide outreach and commentary on the development, progress, and direction of NORA implementation.

In 1999, the Liaison Committee undertook a survey of key occupational safety and health stakeholders to gauge their opinions regarding NORA and to measure progress in NORA implementation. Of the 948 respondents, 42 percent reported that they were aware of NORA. Among this group, 30 percent reported that NORA had changed the research priorities of their organizations. Twenty percent reported that NORA had increased funding for their organization's research and 35 percent responded that NORA had increased partnerships between both researchers and organizations. Additionally, 47 percent responded that NORA had increased the quality of occupational safety and health research. The Liaison Committee is currently planning a repeat survey for the summer of 2002, with results to be presented at the 2003 NORA Symposium.

As of 2000, the Liaison Committee is also responsible for administering the NORA Partnering Award for Worker Safety and Health, which is described on page 27 .

Federal Liaison Committee

The Federal Liaison Committee (see listing on next page) is an interagency working group guiding the implementation of NORA. In 2001, the Committee undertook the third biennial survey of federal investment in NORA and in occupational safety and health research overall. The first survey, covering FY 1996, provided a baseline identifying a total of only $199 million spent for all occupational safety and health research from the survey respondents (including NIOSH), compared to $218 million in FY 1998, and $266 million in FY 2000. (For more information, see page 10.)

Members of the Federal Liaison Committee have also been active in leveraging additional resources for NORA. In FY 2001, NIOSH and 15 federal partners announced grant funding in the NORA priority research areas for the fourth consecutive year (see description on page 15).

Federal Liaison Committee

FEDERAL AGENCY	OFFICE/INSTITUTE/DIVISION
Consumer Product Safety Commission	Division of Health Sciences
Department of Agriculture	Cooperative State Research, Education and Extension Service
Department of Defense	Office of Naval Research
Department of Energy	Office of the Environment, Safety and Health
Department of Health and Human Services	Agency for Health Care Research and Quality Agency for Toxic Substances and Disease Registry Centers for Disease Control and Prevention Epidemiology Program Office National Center for Chronic Disease Prevention and Health Promotion National Center for Environmental Health National Center for Health Statistics National Center for HIV, STD, and TB Prevention National Center for Infectious Disease National Center for Injury Prevention and Control National Immunization Program Office of Minority Health Office of Women's Health Public Health Practice Program Office Food and Drug Administration Office of Intergovernmental Affairs National Institutes of Health Fogarty International Center National Cancer Institute National Heart, Lung, and Blood Institute National Institute on Aging National Institute of Allergy and Infectious Disease National Institute of Arthritis and Musculoskeletal and Skin Disease National Institute on Deafness and Other Communication Disorders National Institute of Environmental Health Sciences National Institute of Mental Health National Institute of Nursing Research Office of Women's Health Substance Abuse and Mental Health Services Administration
Department of Justice	National Institute of Justice
Department of Labor	Bureau of Labor Statistics Mine Safety and Health Administration Occupational Safety and Health Administration Wage and Hour Division
Department of Transportation	Federal Aviation Administration Federal Highway Administration National Highway Traffic Safety Administration
Department of Veterans Affairs	Veterans Health Administration
Environmental Protection Agency	National Exposure Research Laboratory Office of Prevention, Pesticides, and Toxic Substances

NIOSH/NORA Partnership Structure

National Institute for Occupational Safety and Health

Washington, DC
Office of Health Communication
Office of Policy and Legislation
Office of the Associate Director for Science
Office for Mine Safety and Health Research

Atlanta, GA
Office of Extramural Programs
Office of Administration and Management Services

Cincinnati, OH
Division of Applied Research and Technology
Division of Surveillance, Hazard Evaluations, & Field Studies
Education & Information Division
Office of Compensation Analysis and Support

Morgantown, WV
Division of Respiratory Disease Studies
Division of Safety Research
Health Effects Laboratory Division

Pittsburgh, PA
Pittsburgh Research Laboratory
National Personal Protective Technology Laboratory

Spokane, WA
Spokane Research Laboratory

Office of the Director
Washington, DC

Deputy Director for Program
Washington, DC

Deputy Director for Management
Atlanta, GA

NORA Liaison Committee

NORA Federal Liaison Committee

NORA PARTNERSHIP TEAMS

Team Name
Team Leader
Team Members
(# NIOSH # External)

Allergic & Irritant Dermatitis
Boris Lushniak
G. Frank Gerberick
6 NIOSH 7 External

Asthma & Chronic Obstructive Pulmonary Disease
Paul Henneberger
8 NIOSH 5 External

Cancer Research Methods
Paul Schulte
Elizabeth M. Ward
8 NIOSH 10 External

Control Technology & Personal Protective Equipment
Larry Reed
8 NIOSH 8 External

Emerging Technologies
Aaron Schopper
7 NIOSH 9 External

Exposure Assessment Methods
Mary Lynn Woebkenberg
8 NIOSH 7 External

Fertility & Pregnancy Abnormalities
Teresa Schnorr
5 NIOSH 8 External

Health Services Research
Scott D. Deitchman
5 NIOSH 8 External

Hearing Loss
John R. Franks
5 NIOSH 10 External

Indoor Environment
Mark Mendell
5 NIOSH 8 External

Infectious Diseases
David Weissman
5 NIOSH 14 External

Intervention Effectiveness Research
Raymond Sinclair
5 NIOSH 11 External

Mixed Exposures
Frank Hearl
5 NIOSH 8 External

Musculoskeletal Disorders
Thomas Waters
6 NIOSH 10 External

Organization of Work
Steve Sauter
8 NIOSH 7 External

Risk Assessment Methods
Leslie Stayner
5 NIOSH 7 External

Social & Economic Consequences of Workplace Illness & Injury
Elyce Biddle
6 NIOSH 11 External

Special Populations at Risk
Sherry Baron
Rosemary Sokas
8 NIOSH 11 External

Surveillance Research Methods Implementation Team
John Sestito
8 NIOSH 9 External

Traumatic Injuries
Nancy Stout
7 NIOSH 7 External

Partnership Teams

Fundamental to the success of NORA are the contributions of the Partnership Teams. The Teams' ability to involve key stakeholders in the priority areas, define research needs, and leverage resources for research areas is critical to the implementation of the Agenda.

Each team consists of a team leader, NIOSH researchers, and external partners. The 20 partnership teams have brought together 128 NIOSH researchers and 175 external members (see inside front and back covers for team membership). External membership includes faculty from public and private colleges and universities, representatives of professional organizations and major industries, leaders in the insurance industry, health and safety professionals from organized labor, and representatives from other government agencies. The following summaries highlight the work of each of the 20 NORA Partnership Teams.

Team Summaries

Allergic and Irritant Dermatitis Team

The Allergic and Irritant Dermatitis (AID) Team mission is to develop a broad-based, active, and lasting group to catalyze research in AID. The NORA AID team played an important role in establishing the intramural NIOSH Derm Interest Group (DIG). To date, AID Team accomplishments include: 1) organizing and co-sponsoring meetings in the occupational safety and health and dermatology community; 2) enhancing dermatology-related activities through intramural and extramural research; and, 3) developing research priorities. In May 1999, the Experimental Contact Dermatitis Research Group (ECDRG) convened, sponsored by NORA AID Team/NIOSH, the Skin Disease Research Centers at the University of Texas Southwestern Medical Center, Case Western Reserve University/University Hospitals of Cleveland, and the Procter & Gamble Company. Participants discussed the basic and applied science of experimental contact dermatitis. In March 2000, the NORA AID Team/NIOSH sponsored the Donald J. Birmingham Occupational Skin Diseases Session at the Annual Meeting of the American Contact Dermatitis Society (ACDS). In November 2000, the team co-sponsored "Contact Dermatitis 2000 — Blending Science with Best Practice," held at the University of Texas Southwestern Medical Center in Dallas. The meeting was organized by the ECDRG and the ACDS and was co-sponsored by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), NIOSH, and the Skin Disease Research Centers at the University of Texas Southwestern Medical Center. In March 2001, the NORA AID Team/NIOSH sponsored the second annual Donald J. Birmingham Occupational Skin Diseases Session at the Annual Meeting of the ACDS. In FY 1998, NIOSH and NIAMS co-funded an RFA for irritant dermatitis and funded five AID projects. In FY 2000, NIOSH funded an inter-divisional intramural research program, Developing Dermal Policy Based on Lab and Field Studies. Also in FY 2000, three extramural projects were funded under the NORA AID priority area and two more derm-related projects were funded under other NORA priority areas (Surveillance Research Methods and Exposure Assessment Methods). The team has been working on developing research priorities in AID in the following areas: basic biomedical sciences, clinical/epidemiology/surveillance, exposure, and risk assessment/prevention.

Asthma & Chronic Obstructive Pulmonary Disease Team

The Asthma & Chronic Obstructive Pulmonary Disease Team continues its successful partnerships with federal agencies to increase resources available for extramural research on occupational asthma and chronic obstructive pulmonary disease (COPD). Requests for applications for such research have been jointly supported with the National Heart, Lung, and Blood Institute (NHLBI) in each of the last four years. In addition, NIOSH has partnered with the CDC's National Center for Environmental Health (NCEH) and Agency for Toxic Substances and Disease Registry (ATSDR) to fund two cooperative agreements to determine the population-based proportion of incident asthma cases attributable to occupational exposures. Intramurally, NIOSH sponsors a major initiative on research for occupational asthma reduction, including projects on building-related asthma in offices and schools, workplace exacerbation of pre-existing asthma, medical monitoring for isocyanate asthma, and latex asthma in Veterans Administration hospitals. The team hosted an international symposium on asthma in 1998; a workshop on questionnaire revisions pertinent to building-related asthma in 1999; an ad hoc committee meeting of the American Thoracic Society (to prepare a published statement on the work-attributable proportion of occupational asthma and COPD); a workshop on work, smoking, and health in June 2000; and a workshop on novel methods of bioaerosol assessment in September 2000.

Cancer Research Methods Team

The NORA Cancer Research Methods Team has been reviewing methodologies that can impact occupational cancer research. The methodologies range from the microlevel (such as structure-activity relationships to predict carcinogens) to the macrolevel (such as improvements for exposure assessments in epidemiological studies). The team plans to publish a white paper on research needs and gaps for cancer research methods in four areas: carcinogen identification, epidemiological studies, risk assessment, and prevention. A workshop on new methods in high-throughput technologies, cross-species comparisons, and intermediate biomarkers related to occupational cancer research is being planned.

Control Technology & Personal Protective Equipment Team

The Control Technology and Personal Protective Equipment Team, in conjunction with the American Industrial Hygiene Association (AIHA) and the American Society of Safety Engineers (ASSE), held a unique conference and workshop in 1998, The Control of Workplace Hazards for the 21st Century: Setting the Research Agenda. It brought together over 250 researchers, manufacturers, and users of engineering controls and personal protective equipment. The participants created a future control technology research agenda for six areas: chemical protective clothing, engineering controls, noise, non-ionizing radiation, respirators, and traumatic injuries.

Emerging Technologies Team

The NORA Emerging Technologies Team is working to establish mechanisms to ensure that worker health and safety is considered when new technologies are developed and implemented. The team is seeking partners interested in co-sponsoring research to bring advanced and emerging technologies to bear on occupational safety and health concerns. Along with the U.S. Coast Guard, the team is currently co-sponsoring the National Aeronautics and Space Administration's Human Systems 2001 conference to be held June 20-22, 2001 near the Johnson Space Center in Houston.

Exposure Assessment Methods Team

The Exposure Assessment Methods Team is composed of members representing various disciplines (e.g., chemistry, biology, industrial hygiene, occupational health

nursing, toxicology, and epidemiology) from government, academia, labor, and industry. The team has co-sponsored a symposium on Exposure Assessment with the American Conference of Government Industrial Hygienists (ACGIH); served on the planning committee, with the National Institute of Environmental Health Sciences (NIEHS)/ National Toxicology Program, of a workshop on the role of human exposure assessment in the prevention of environmental disease; and served on the planning committee of the International Symposium on Occupational Exposure Data Bases and Their Application in the Next Millennium. The team completed a draft white paper that addresses key exposure assessment issues such as field study design, monitoring methods development, and toxicology research, along with education and communication needs relative to exposure assessment.

Fertility and Pregnancy Abnormalities Team

The mission of the Fertility and Pregnancy Abnormalities Team is to assist in the development and pursuit of reproductive health research. In 2000, the team, along with the Control Technology and Personal Protective Equipment Team, organized a working group to address the issue of safe handling of hazardous drugs among healthcare workers. Stakeholders attending the initial meeting in September 2000 included representatives of drug manufacturers, clinical pharmacists (the American Society of Health-System Pharmacists), nursing organizations (the Oncology Nursing Society, the American Nurses Association (ANA)), care providers, end users, healthcare unions (the Service Employees International Union, the ANA), several control technology companies, researchers from academia, attendees from a number of federal public health agencies (the Food and Drug Administration (FDA), the National Institutes of Health (NIH), the Occupational Safety and Health Administration (OSHA), NIOSH), the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO), the March of Dimes, and other reproductive hazards prevention groups. The purpose of this working group is to review scientific knowledge of healthcare worker exposure, current handling practices, and existing control technologies to mitigate exposure during transportation, preparation, administration and waste handling of the drugs.

Also in 2000, with National Institute of Environmental Health Sciences (NIEHS), the team co-sponsored the conference: Comparing and Contrasting Reproductive Toxicity Testing. The team co-sponsored an RFA on endocrine disruptors and reproductive/developmental effects with the Environmental Protection Agency (EPA), NIEHS and National Cancer Institute (NCI). In 2001, NIOSH funded an RFA on occupational exposure to putative reproductive/developmental toxicants in humans. The team is developing a paper on current needs in occupational reproductive health to help encourage the most-needed research. The team, NIEHS, and the Institute of Medicine (IOM), will co-sponsor a conference on occupational and environmental influences on prematurity in October 2001.

Health Services Research Team

The Health Services Research Team seeks to define and promote research into the delivery of health care to workers. In June 1999, the team co-hosted the conference, Functional, Economic, and Social Outcomes of Occupational Injuries and Illnesses: Integrating Social, Economic, and Health Services Research in Denver, Colorado. This conference brought together NORA team members and other researchers in the fields of occupational health services research and social and economic consequences of occupational injury and illness. Ten commissioned papers served as the starting point for discussions of current needs, challenges, and priorities for research in these areas. Using this information, the Health Services Research Team is developing a white paper to identify key research priorities. In addition, papers from the conference are in peer

review for publication. Team members are participating in a research project funded by the Robert Wood Johnson Foundation to create performance measures for occupational health services provided in managed care. Several research papers from this project have been drafted for submission to peer-reviewed journals. Team members also contributed to an announcement of grant funds for students training in occupational health services research.

Hearing Loss Team

The Hearing Loss Team identifies and prioritizes research needs to develop studies to fill existing research gaps. A white paper, to be published in 2001, will examine the key areas of hearing loss prevention. It will recommend new strategies for the prevention of occupational hearing loss and identify information gaps. The effectiveness of strategies (personal protection, engineering controls, etc.) for hearing loss prevention will be reported in the white paper and noted as part of the assessment and surveillance activities. The Hearing Loss Team sponsored two best-practices conferences focused on assessing the status of occupational noise exposure and hearing loss (cross sectional and longitudinal surveillance) and noise exposure control technology (including hearing protection) primarily in the construction and mining sectors. The first, held in Detroit, Michigan in October 1999, focused on the manufacturing sector and was cosponsored by NIOSH, Wayne State University, and the National Hearing Conservation Association. The second best-practices conference, held in Washington, D.C. in March 2000, focused on construction and was cosponsored by NIOSH, the Occupational Safety and Health Administration (OSHA), and the Laborers' International Health and Safety Fund of North America. Information from these conferences will help create an encyclopedia of effective noise control technology information including case studies for use by industry. The Hearing Loss Team will sponsor future best-practices and state-of-the-art conferences addressing small business, as well as new strategies for protecting workers from hearing loss due to impulsive noise and exposure to chemicals and noise. The team will also develop model curricula for the training of graduate students in audiology, industrial hygiene, and industrial safety in noise control and occupational hearing loss prevention. These curricula will be provided as templates to the professional accrediting or certifying organizations.

Indoor Environment Team

The goal of the NORA Indoor Environment (IE) Team is to focus and facilitate research, through broadly based multi-sector partnerships, that will improve the health of workers in indoor environments. The IE team has produced a research agenda that will be published as a scientific article. The agenda gives priority to three research topics: causes and prevention of specific building-related health effects (building-influenced transmission of communicable infections, building-related asthma and allergy, and nonspecific building-related symptoms); indoor environment and building science; and barriers and incentives for the implementation of health protective features and practices in buildings. The research agenda and increased NIOSH extramural funding have stimulated a large increase in the number and rigor of IE-related research proposals in the U.S. NIOSH funded two extramural projects in FY 1998 and two in FY 1999. Three are blinded, controlled intervention studies. The studies examine ventilation, viral respiratory infections, and illness absence; the joint health effects of volatile organic compounds, ozone, and stress; and the health benefits of in-duct ultraviolet radiation. The fourth project is the development of a hand-held instrument to identify and quantify low concentrations of mixed volatile organic compounds. A large intramural research initiative within NIOSH is underway on respiratory disease in indoor work environments with primary direction from the NORA Asthma and Chronic Obstructive Pulmonary Disease Team.

Infectious Diseases Team

The NORA Infectious Diseases Team is focused on the problem of occupationally-related infectious diseases. The team is composed of members drawn from labor, corporate management, academia, and government, representing a wide range of disciplines and disease-specific expertise. Recent concerns and areas of activity by team members include occupationally-encountered blood-borne pathogens, such as human immunodeficiency virus (HIV) and various types of hepatitis and the prevention of transmission of tuberculosis in occupational settings. The team has conducted meetings to discuss research needs for occupationally-related infectious diseases and has generated a draft position statement about research needs. The team has also served as a resource for guidance and information about research on occupationally-related infectious diseases at NIOSH. It is our goal to remain a strong advocate in support of research in this important area. The Infectious Disease Team also conducted a session at the American Occupational Health Conference (AOHC), sponsored by the American College of Occupational and Environmental Medicine (ACOEM), to review research priorities in occupationally-related infectious diseases.

Intervention Effectiveness Research Team

The Intervention Effectiveness Research (IER) Team's mission is to: 1) increase the awareness and appreciation of the value of occupational safety and health intervention research, 2) increase the understanding and use of optimal research methods for conducting IER, 3) promote investment in IER across OSH fields, and 4) broaden dissemination of results and lessons learned from occupational safety and health intervention research. These goals are pursued through a variety of educational and training activities. Recently, the team collaborated with the Institute of Labor and Health in Toronto, Canada, to publish an extensive "how-to" intervention evaluation manual for safety and health researchers and professionals. The manual is being marketed for the training of occupational safety and health researchers and professionals and as a resource for practicing researchers and professionals. The team submitted a journal article describing the major goals, phases, and activities of intervention research, to facilitate research planning and review. The team is developing a brief, practical manual to assist employers and workers to conduct practical evaluations of safety and health interventions in their workplaces. The team conducts a case-based workshop exercise to train safety and health professionals to think critically when developing, implementing, and evaluating interventions. The workshop exercise is presented at safety and health conferences. The team promotes increasing intervention research within NIOSH and through NIOSH funding. In the future, the team will build partnerships for intervention research between NIOSH and other organizations in the public and private sectors. It is also consulting national leaders in the evaluation research field as it works to shape the IER agenda.

Mixed Exposures Team

During the past year the Mixed Exposures Team facilitated NIOSH-NORA participation in a joint Environmental Protection Agency (EPA) - National Institute of Environmental Health Sciences (NIEHS) - NIOSH RFA on chemical mixtures. Approximately $5 million was made available for investigator initiated research under EPA's Science to Achieve Results (STAR) program (the announcement can be viewed on the Internet at http://es.epa.gov/ncerqa/rfa/mixtures00.html). The Mixed Exposures Team continues to develop its research agenda and strategy in partnership with other Federal agencies and through participation in ongoing technical meetings. In September 2000, the team met with Federal partners from the Agency for Toxic Substances and Disease Registry (ATSDR), the Department of Defense (DOD), EPA, the Department of Energy (DOE), and the Food and Drug Administration (FDA). All have a keen interest in the toxicology and

approach to risk assessment for complex mixture exposures. The team also participated in the January 2001 meeting on Application of Technology to Chemical Mixture Research, held at Colorado State University (CSU), and jointly sponsored by CSU and NIEHS. The team continues to facilitate communications and collaboration among researchers and those interested in mixed exposures through a listserv and a site on the Internet. Instructions for joining the listserv are provided on the Mixed Exposures Team Internet site at http://www.cdc.gov/niosh/mixed.html.

Musculoskeletal Disorders Team

In 2001 the NORA Musculoskeletal Disorders (MSD) team published a research agenda entitled *Research Topics for the Next Decade*. The team collectively compiled a list of national and international organizations and professionals interested in the area of musculoskeletal disorders for dissemination. The team co-sponsored a conference, "3rd Annual Applied Ergonomics Conference," in March 2000 in Los Angeles, California. At the conference the team organized a session focused on ergonomics issues in health care that was open to the public. The team has organized a session at the Human Factors and Ergonomics Conference in October 2001 in Minneapolis, Minnesota. The goal of the session is to inform professionals who are working on MSDs of the new NORA MSD research agenda. During the coming months the team will be writing two journal articles (for *Professional Safety* and *Ergonomics*) about the research agenda. Future goals are to make the research agenda well known to the professional ergonomics community and to begin partnering with foundations and other groups to collectively work on the research agenda.

Organization of Work Team

The Organization of Work Team has met on a regular basis since 1998 to consider the changing nature of work, potential health and safety risks, and prevention strategies. In 1999 the team participated in many activities to better understand knowledge gaps and research needs. It held an outreach workshop with key interest groups in Baltimore, Maryland where team members met with representatives from national and international stakeholder organizations to discuss three topics: 1) how the organization of work is changing, 2) safety and health implications of these changes, and 3) interventions for reducing safety and health risks. Information from this meeting is being integrated into a strategic report on work organization and health research needs. Also in 1999, the team sponsored (with the American Psychological Association) an international scientific conference on work organization and health. Team members delivered technical presentations on safety and health concerns in the changing organizational environment at meetings of the European Agency for Safety and Health at Work, the American Industrial Hygiene Association (AIHA), the Academy of Management, and the American Public Health Association (APHA). In 2000, the team began planning for Federal interagency partnerships to 1) improve surveillance and data collection for research priority setting relating to changing work organization and safety and health consequences, and 2) combine efforts and leverage funding to support research on this topic. In this regard, team members were instrumental in developing a NIOSH extramural program announcement in FY 2001 for research on long hours of work and safety and health. At the National Occupational Injury Research Symposium (NOIRS), 2000, the team organized the first-ever scientific session on work organization and injury. Publication of a team report in a major peer-review journal is anticipated in 2001, and the team will co-sponsor an international meeting on work organization and health in 2003.

Risk Assessment Methods Team

The Risk Assessment Methods Team defined ten research areas to promote improvements in risk assessment methodologies. NIOSH funded one research area in a Cooperative Agreement with researchers at the University of North Carolina. The research will evaluate the degree of concordance between toxicologic and epidemiologic estimates of risk for carcinogenic hazards. NIOSH, Environmental Protection Agency (EPA), and National Cancer Institute (NCI) funded a 1999 RFA focused on the development of cancer risk assessment methods and practices. The team also organized a workshop, on "Future Research to Improve Risk Assessment Methods" in August 2000 in Aspen, Colorado. The primary purpose of this workshop was to further develop a national research agenda for risk assessment methods. Proceedings from the workshop are anticipated to be published this summer in the *Journal of Human and Ecological Risk Assessment*.

Social and Economic Consequences of Workplace Illness and Injury Team

The Social and Economic Consequences of Workplace Illness and Injury Team has focused on finalizing a research agenda and devising methods to implement that agenda. The priority research areas identified were Family Impacts, Distribution of Consequences, Effects on Special Populations, Consequences to Employers, Worker Disability and Career Opportunities, Macroeconomic Impacts, Return to Work, Evaluation of Institutions and Mechanisms of Compensation, Income Support and Insurance, and Cost Outcome Analysis. These nine areas were selected through collaboration and by sharing ideas included or triggered by the 1999 team-sponsored conference. These areas are not the only topics of concern, but they are the most pressing topics over the next few years. The implementation methods include building awareness of the social-and-economic-consequences research needs within the safety and health research community and developing tools to assist researchers in their efforts. The three tools slated for completion in the near future are a database of researchers and information about their current research; an inventory of data sources used in these fields; and an annotated bibliography of the social consequences of occupational illness and injury. The implementation plan is meant to increase research by promoting internal projects, building and maintaining external research partners, and stimulating additional funding opportunities. The draft document is being revised with an anticipated publication date of summer 2001.

Special Populations at Risk Team

The Special Populations at Risk Team is involved in a number of projects aimed at promoting new methods and approaches for addressing the occupational health of populations that are frequently under-represented in traditional occupational health research including young and old workers, immigrant and minority workers, and disabled workers. The team sponsored sessions at the October 2000 National Occupational Injury Research Symposium (NOIRS) in Pittsburgh and at the annual American Public Health Association (APHA) meeting in Boston in November 2000. In addition, the team sponsored a symposium in August 2000 for NIOSH researchers. The symposium addressed the interaction between race, socio-economic status, and occupational health outcomes among minorities with disproportionate rates of unemployment and underemployment. During the past year, the team has begun an initiative to develop a research agenda for low income, immigrant, and minority workers. This effort builds on the initiatives undertaken by other parts of CDC and other health researchers to develop a better research base to address the well-documented health disparities among racial and ethnic minority populations in the United States. This year NIOSH partnered with several National Institutes of Health (NIH) institutes to fund a series of research grants aimed at addressing these issues. Three grants totaling more

than $1.5 million per year for the next 5 years were awarded to researchers to address health disparities resulting from occupational exposures. The Special Populations at Risk Team will be working with these researchers and other intramural and extramural researchers around the country to better define the challenges and new directions for research to address the needs of these hard-to-reach populations. Additionally, the team is initiating an effort to collaborate with researchers around the country to better coordinate and compare data on diverse low income immigrant and minority working populations. The research track at the annual Migrant Stream Forum meeting, established by NORA team members, is in its fourth year. The research listserv, a direct outgrowth of this effort, has proven extremely successful.

Surveillance Research Methods Team

The Surveillance Research Methods Team contributed significantly to the NIOSH surveillance strategic planning effort. The synthesis from this strategic planning initiative was recently disseminated by NIOSH as *Tracking Occupational Injuries, Illnesses and Hazards: the NIOSH Surveillance Strategic Plan*. Team members also contributed content and review for the NIOSH *Worker Health Chartbook, 2000*. The recently released Surveillance Strategic Plan identifies the goal of promoting occupational safety and health surveillance conducted by employers, unions, and other non-governmental organizations. The Surveillance Research Methods Team is holding a workshop in Cincinnati, Ohio, November 7-9, 2001 on Best Practices in Workplace Surveillance: Identification and Tracking of Workplace Injury, Illness, Exposures, and Hazards. This workshop will bring together private sector safety and health professionals, public health professionals, scientists, and policy-makers to advance communication and cooperation and contribute to the development of a more detailed research agenda.

Traumatic Injuries Team

Team members assisted with final planning and implementation of the National Occupational Injury Research Symposium (NOIRS) 2000, held in Pittsburgh, Pennsylvania in October 2000. The Symposium was jointly sponsored with the American Society of Safety Engineers (ASSE) and Liberty Mutual Research Center. Several NORA teams, including the Special Populations at Risk Team, Organization of Work Team, Social and Economic Consequences of Workplace Illness and Injury Team, and the Intervention Effectiveness Team, participated in the symposium by organizing special sessions on crosscutting topics. The Symposium was extremely well-attended and productive. At the recommendation of the editor of the journal *Injury Prevention*, a special issue, anticipated for this fall, will feature articles from NOIRS 2000. The team met in June 2000 in Dearborn, Michigan. Ford and the United Auto Workers (UAW)-Ford National Joint Committee on Health and Safety sponsored this meeting that included a tour of a Ford truck plant and a hands-on presentation/demonstration of Ford's surveillance system. The team met in November 2000 in Itasca, Illinois, at the National Safety Council (NSC) facility. The primary focus of these meetings was to better understand how a company-level surveillance system can identify hazards and risks, monitor the effectiveness of injury prevention measures, and identify research gaps in existing surveillance systems. The team is organizing and sponsoring a special symposium at the National Safety Council Congress, September 24-26, 2001 in Atlanta, Georgia. "Making Science Work for You: A Symposium for Safety Professionals" focuses on the role of science in injury prevention, and on the application of results of injury research in the workplace. The team members, along with industry and labor partners, will be presenting the Symposium in a series of six technical sessions over the 3-day period. This forum will facilitate dissemination to and interaction with the industry safety community. This is an important, often difficult-to-reach audience, that can apply research results to prevent injuries in the workplace.

NORA Milestones
July 1995 - June 2001

NORA Development

July 1995 ..... NIOSH commits to lead the creation of a research Agenda for occupational safety and health

September 1995 ... Agenda framework developed and 50 potential topics identified by an initial working group of internal and external scientists

November 1995 .... First National public meeting convened to provide input into the Agenda and discuss criteria for priorities

January 1996 ..... Four additional working groups (NIOSH, external researchers, health professionals, other stakeholders) expand and prioritize research areas

February 1996 ..... Three town meetings (Boston, Chicago, and Seattle) convened

March 1996 ..... Second national public meeting held to review the draft Agenda

April 1996 ..... Final Agenda unveiled – The National Occupational Research Agenda identified 21 priority research areas to guide occupational safety and health research (released on NIOSH's 25th Anniversary)

NORA Implementation Year 1

November 1996 .... Partnership teams formed for each priority area to implement NORA

February 1997 ..... First ever survey conducted of federal (non-NIOSH) resources (FY 1996) committed to occupational safety and health research

July 1997 ..... First NORA Implementation Symposium held at the National Academy of Sciences, Washington, D.C.

NORA Update 1997 document released

NORA Implementation Year 2

November 1997 .... Congress appropriated $5 million for the implementation of NORA

Jan-Feb 1998 ..... Three NIH Institutes each contributed $1 million to NORA research priorities

March 1998 ..... NIOSH and NIH partners announced a Request for Applications (RFA) for the largest ever funding for targeted occupational safety and health research ($8 million)

American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine established a joint research award, giving emphasis to NORA in the selection criteria

April 1998 ..... NORA logo created

May 1998 ..... NORA and the asphalt partnership both selected as semifinalists (two of 100 semifinalists; two of 19 federal semifinalists) for the Ford Foundation and Harvard University's 1998 Innovations in American Government Awards Program from an initial pool of 1,420 applicants

First issue of the NORA newsletter, *NORA News*, distributed

NORA Web site mounted

July 1998 ..... NORA Update 1998 document released

September 1998 ... Asphalt research partnership selected as one of 25 finalists in the 1998 Innovations in American Government awards program

First private sector funds (Aetna U.S. Health Care) leveraged for NORA research (musculoskeletal disorders project)

MILESTONES

MILESTONES

NORA Implementation Year 3

October 1998 ..... First NORA research grants announced–50 grants totaling $8 million make up the single largest infusion of funding ever by the federal government for extramural investigator-initiated occupational health and safety research

NIOSH received permission to trademark the NORA logo

Congress continued to provide support for NORA through an $11 million appropriation in the FY 1999 NIOSH budget

February 1999 ..... The President's FY 2000 budget proposal to Congress included $12 million for NORA to support both intramural and extramural research and related activities

March 1999 ..... Second survey of federal (non-NIOSH) resources (FY 1998) committed to occupational safety and health research conducted

Liaison Committee conducted two surveys to determine the effectiveness and reach of NORA among associations and private industry

NIOSH/NIH invited NORA grant applications for FY 1999 ($9 million)

April 1999 ..... NIOSH/EPA/NCI announced RFA for $1.5 million for research focusing on the development of cancer risk assessment methods and practices

May 1999 ..... NORA Update 1999 document released

First NORA Partnering Award For Worker Health and Safety awarded to the Asphalt Research Partnership

NORA Symposium 1999: Partnership for Research held at the National Academy of Sciences, Washington, D.C.

NIOSH announced a cooperative agreement with the Association of Schools of Public Health to solicit applications for intervention effectiveness research.

NIOSH announced an RFA to fund research on intervention effectiveness

August 1999 ..... NIOSH/NIH invited applications through a general program announcement (PA) for research in the 21 NORA priority areas

NIOSH/NCI/NIEHS announced a PA on research methods for occupational cancer

NIOSH announced the availability of approximately $500,000 in grants to train occupational health services researchers

NORA Implementation Year 4

October 1999 ..... NIOSH awarded $5.4 million in grant funds for 23 projects in seven NORA areas

November 1999 .... Congress continued to provide support for NORA through a $11.3 million appropriation in the FY 2000 NIOSH budget

NIOSH/NIEHS and five other NIH partners announced a $5 million RFA to stimulate new research on risk disparities among special populations

February 2000 ..... The President's FY 2001 budget proposal to Congress included $4.9 million to support research under NORA

March 2000 ..... NIOSH announced RFAs for intervention effectiveness ($1.2 million); surveillance research ($2.5 million); exploratory research in allergic and irritant dermatitis, social and economic consequences of workplace injury and illness, health services research, and fertility and pregnancy abnormalities ($1 million); agriculture-related injuries to children ($1.6 million) and musculoskeletal disorders ($0.9 million).

April 2000 ..... NIOSH/EPA/NIEHS announced a $5 million RFA on mixed exposures

May 2000 ..... NORA Update 2000 document released

June 2000 ..... NIOSH/NIH/EPA announced a $6 million RFA on endocrine disruptors and adverse health effects in humans, particularly on reproductive and development effects

December 2000 .... Congress continued to provide support fro NORA through a $9.2 million appropriation in the FY 2001 NIOSH budget

NORA Implementation Year 5

February 2001 ..... NIOSH announced RFAs for traumatic occupational injury research ($1 million); extended work schedules ($1 million); and reproductive/developmental toxicants ($2 million)

Third survey of Federal (non-NIOSH) resources (FY 2000) committed to occupational safety and health research conducted

March 2001 ..... NIOSH announced training grants for occupational injury prevention ($1 million)

April 2001 ..... NIOSH celebrated its 30th Anniversary

NORA marked its fifth year

The President's FY 2002 budget proposal to Congress included $1 million to support research under NORA

June 2001 ..... NORA Symposium 2001: Leading Research in Occupational Safety and Health held in Washington, D.C.

Second NORA Partnering Award for Worker Health and Safety awarded to Oregon for "A Strategic Plan for Reducing Occupational Dermatitis in Oregon." Partners in Alaska were awarded Honorable Mention for "Crab Related Respiratory Illness in Dutch Harbor, Alaska."

NORA Update 2001 document released

MILESTONES

SUMMARY

Summary

At the midpoint of its implementation, NORA continues to evolve and thrive. Those dedicated to NORA and occupational safety and health have produced

- An enthusiastic and productive, broad-based NORA Liaison Committee.
- Successful efforts of 20 NORA Teams, including outreach, conferences and symposia, and the production of research agendas.
- A successful grant process that produced record-breaking funding for targeted occupational safety and health research in Fiscal Years 1998, 1999, 2000, and 2001.
- Three surveys (FY96, FY98, FY00) of Federal occupational safety and health research investment, showing increases in Federal partner funding in occupational safety and health in general, and NORA in particular.
- Evidence that a national research agenda was, and continues to be, needed and that NORA research priority areas were well chosen with broad input and growing support.
- Recognition that NORA is a model for public-private partnerships and is being widely used by other organizations in similar planning efforts.
- The first broad-based network of public and private partnerships in occupational safety and health.

(continued from inside front cover)

Robert Lyerla (National Center for Infectious Diseases/CDC)
Marissa A. Miller (National Institute of Allergy and Infectious Diseases/NIH)
Adelisa L. Panlilio (National Center for Infectious Diseases/CDC)
Renee Ridzon (Division of Tuberculosis Elimination/CDC)
Gary Roselle (Veterans Affairs Headquarters)
Kevin Seifert (Becton Dickinson and Company)
Teresa Seitz (NIOSH)
Hillary Sigmon (National Institute of Nursing Research/NIH)
Kent A. Sepkowitz (Memorial Sloan-Kettering Center)

Intervention Effectiveness Research

Raymond Sinclair (NIOSH) RSinclair@cdc.gov
Theodore M. Katz (NIOSH) tmk1@cdc.gov
Robin Baker (University of California)
Denis R. Bourcier (The Boeing Company)
Ann Brockhaus (Organization Resources Counselors, Inc.)
Larry Chapman (University of Wisconsin)
Patrick Coleman (NIOSH)
Jim Collins (NIOSH)
Linda Goldenhar (University of Cincinnati)
Cathy Heaney (Ohio State University)
Tony LaMontangne (Dana Farber Cancer Institute)
John Martonik (Occupational Safety and Health Administration)
Ivan Most (Strategic Occupational Health Management)
Paul Landsbergis (Mount Sinai Medical Center)
Ted Scharf (NIOSH)
Scott P. Schneider (Laborers' Health and Safety Fund of North America)

Mixed Exposures

Frank Hearl (NIOSH) fjh1@cdc.gov
Nancy Bollinger (NIOSH)
Hank Gardner (AMC Cancer Research Center)
Manuel Gomez (American Industrial Hygiene Association)
Hugh Hansen (Agency for Toxic Substances and Disease Registry)
Robert Herrick (Harvard School of Public Health)
Richard C. Hertzberg (Environmental Protection Agency)
Vera Kommineni (NIOSH)
Daniel Lewis (NIOSH)
Alan Lunsford (NIOSH)
Joe L. Mauderly (Lovelace Respiratory Research)
Carlos Marentes (Rural Coalition)
Pam Susi (Center to Protect Workers Rights)

Musculoskeletal Disorders

Thomas R. Waters (NIOSH) Twaters@cdc.gov
Gunnar Andersson (Rush-Presbyterian-St. Luke's Medical Center)
Vernon Putz Anderson (NIOSH)
Lida Orta-Anes (International Union, United Auto Workers)
Bruce Bernard (NIOSH)
Robert E. Bonner (AETNA)
Stephen Brightwell (NIOSH)
LaMont Byrd (International Brotherhood of Teamsters)
Cheryl Fairfield Estill (NIOSH)
Hongwei Hsiao (NIOSH)
Tom Leamon (Liberty Mutual Insurance Company)
Jim Panagis (National Institute for Arthritis and Musculoskeletal and Skin Diseases/NIH)
Priscilla Shoemaker (American Health Care Association)
Barbara Silverstein (SHARP, Washington State Dept. of Labor & Industries)
Tom Slavin (Navistar International Transportation Corporation)
Laura Welch (Washington Hospital Center)

Organization of Work

Steven L. Sauter (NIOSH) sls4@cdc.gov
W. Stephen Brightwell (NIOSH)
Michael Colligan (NIOSH)
Joseph J. Hurrell (NIOSH)
Theodore M. Katz (NIOSH)
Gwendolyn Keita (American Psychological Association)
David LeGrande (Communications Workers of America)
Nancy Lessin (Massachusetts AFL-CIO)
Jane Lipscomb (University of Maryland)
Lawrence Murphy (NIOSH)
Robert H. Peters (NIOSH)
Sydney Robertson (Organization Resources Counselors, Inc.)
Jeanne Stellman (Columbia University)
Naomi G. Swanson (NIOSH)
Lois E. Tetrick (University of Houston)

Risk Assessment Methods

Leslie Stayner (NIOSH) lts2@cdc.gov
Mike Attfield (NIOSH)
Elaine Faustman (University of Washington)
William Fayerweather (Owens Corning)
Dale Hattis (Clark University)
Herman Gibb (Environmental Protection Agency)
Frank Mirer (United Auto Workers)
William Perry (Occupational Safety and Health Administration)
Al Poland (NIOSH)
Chris Portier (National Institute of Environmental Health Sciences/NIH)
Mark Torrasson (NIOSH)
James T. Wassell (NIOSH)

Social & Economic Consequences of Workplace Illness & Injury

Elyce Biddle (NIOSH) egb6@cdc.gov
Leslie I. Boden (Boston University)
Benjamin C. Amick III (University of Texas)
Laura Blanciforti (NIOSH)
Thomas W. Camm (NIOSH)
Brian T. Day (NIOSH)
Ross Eisenbrey (Occupational Safety and Health Administration)
Theodore M. Katz (NIOSH)
Paul R. Keane (NIOSH)
Chuck Levenstein (University of Massachusetts, Lowell)
Stephen Luchter (National Highway Traffic Safety Administration)
Ted Miller (National Public Service Research Institute)
Sharon Morris (University of Washington)
Robert Reville (The RAND Corporation)
Harry Shannon (McMaster University, Institute for Work & Health)
Eve Spangler (Boston College)
Emily Spieler (University of West Virginia)

Special Populations at Risk

Sherry Baron (NIOSH) slb8@cdc.gov
Rosemary Sokas (NIOSH) rrs8@cdc.gov
Joni Berardino (National Center for Farmworkers' Health)
Dawn Castillo (NIOSH)
Gwendolyn Cattledge (NIOSH)
Letitia Davis (Massachusetts Department of Public Health)
Gayle DeBord (NIOSH)
Howard Frumkin (Emory University)
Jim Grosch (NIOSH)
Frances C. Henderson (Alcorn State University)
James Jackson (University of Michigan)
Jacqueline Nowell (United Food and Commercial Workers International Union)
Pamela Tau Lee (Labor Occupational Health Program)
Luz Maritza Tennassee (Pan American Health Organization)
Leslie MacDonald (NIOSH)
Sandra Stratford (IBM)
Rex Tingle (Occupational Safety and Health Administration)
Jennie Ward Robinson (NIOSH)
David Wegman, (University of Massachusetts, Lowell)

Surveillance Research Methods Implementation Team

John P. Sestito (NIOSH) jps4@cdc.gov
Henry Anderson (Wisconsin Department of Health and Social Services)
Robert Castellan (NIOSH)
Joe Dubois (Occupational Safety and Health Administration)
Richard Ehrenberg (NIOSH)
Barbara Fotta (NIOSH)
Eric Frumin (UNITE Health and Safety Department)
Alice Greife (Central Missouri State University)
Denise Koo (Epidemiology Program Office/CDC)
Wayne M. Lednar (Eastman Kodak)
Jane McCammon (NIOSH)
John Myers (NIOSH)
Steve Newell (Organization Resources Counselors, Inc)
Lee Sanderson (NIOSH)
Anita Schill (NIOSH)
Diane Wagener (National Center for Health Statistics/CDC)
William Weber (Bureau of Labor Statistics)

Traumatic Injuries

Nancy Stout (NIOSH) nas5@cdc.gov
Christine Boldt (NIOSH)
William Borwegen (AFL-CIO, CLC)
Christine M. Branche (National Center for Injury Prevention and Control/CDC)
Timothy R. Fisher (American Society of Safety Engineers)
James Harris (NIOSH)
Alan F. Hoskin (National Safety Council)
Lynn Jenkins (NIOSH)
Herb Linn (NIOSH)
Jan Manwaring (NIOSH)
Gordon R. Reeve (Ford Motor Company)
Gordon Smith (Center for Injury Research)
Gary S. Sorock, Ph.D. (Liberty Mutual Research Center)
Lisa J. Steiner (NIOSH)

SAFER • HEALTHIER • PEOPLE™

For additional information, contact NIOSH at:

1-800-35-NIOSH
(1-800-356-4674)
Fax: 513-533-8573

or visit the NIOSH web site at
www.cdc.gov/niosh

DHHS (NIOSH) Publication No. 2001-147