

From Research to Practice

Strategies and examples from NIOSH

By Nancy Stout and DeLon Hull

NIOSH'S OVERALL GOAL is to prevent illnesses, injuries and fatalities caused by hazards on the job. Through its Research to Practice (r2p) initiative, which integrates the agency's strategic goals of knowledge generation and knowledge transfer, NIOSH translates research findings, technologies and information into highly effective prevention practices and products that can be adopted in the workplace.

The two basic tenets of r2p are relevance and impact. They are accomplished by involving partners and stakeholders throughout the research process—conceiving, planning, conducting, translating and evaluating research—and providing research results to users in a manner and format most useful to them.

Effectively communicating and transferring workplace injury prevention research to practice depends on partnerships with organizations, associations and research institutions, including industry, manufacturers, policy makers, employers and workers themselves. To successfully translate research to practice, researchers must identify and involve the appropriate recipients from the conceptual phase of the study in order to ensure the relevance of the research and to enable workplace implementation of research results for injury prevention.

Through active partnerships with stakeholders, NIOSH focuses research on the most critical occupational safety and health issues; develops useful products; translates research findings into practice; targets dissemination efforts; and evaluates and demonstrates the effectiveness of these efforts in positively affecting worker safety and health. This article describes roles and methods for transferring occupational safety research to practice and provides examples of successful strategies used by NIOSH.

Overview of Strategies

Many different entities have the ability to—and responsibility to—translate and transfer workplace injury prevention research to practice. Only recently, however, has the scientific occupational injury prevention community recognized that researchers also must take responsibility for ensuring that the results

of their research are transferred to or toward workplace application. It is no longer sufficient to accept publication of results in scientific literature as the sole endpoint of researchers' responsibility.

Every research effort—from surveillance and basic laboratory research to field and evaluation studies—must have at least one recipient who will carry out the next step in moving the knowledge or technology toward workplace implementation. There are various types of r2p recipients as well as methods for researchers to facilitate the transfer of research results to practice. Examples include: those who translate scientific information into worker-friendly guidance or training materials; manufacturers who develop and market safety technologies; regulators and employers who promulgate new safety policy; consensus standards bodies that develop or modify guidelines and voluntary standards; trade and labor organizations that promote new safety and health practices; and companies that implement new technologies, processes and practices to prevent injuries among their workforce. The following examples illustrate the roles and methods of transferring research to practice.

Translating Scientific Information into Safety Training Materials

The NIOSH Fatality Assessment and Control Evaluation (FACE) Program identifies prevention strategies based on in-depth investigations of selected types of deaths. Each investigation results in a report that describes the incident and includes recommendations for prevention of similar fatalities. NIOSH has finalized reports on more than 1,600 occupational fatality investigations and has posted them at www.cdc.gov/niosh/face. Examples of FACE report titles include:

- Hispanic Laborer Electrocuted when Crane Boom or Load Line Contacts 7,200 V Overhead Power Line (North Carolina);

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- Traffic Control Supervisor Dies when Struck by an Asphalt Dump Truck while Picking Up Cones on a Roadway Work Zone (Tennessee);
- Sixteen-Year-Old Hispanic Youth Dies after Falling from a Job-Made Elevated Work Platform during Construction (South Carolina);
- Hispanic Roofer Dies after 15-Ft Fall from a Roof (North Carolina);
- Youth Farm Worker Dies after Falling into Operating Feed Grinder/Mixer (Ohio).

The agency has received feedback on the range of ways in which these reports have been used to develop safety training programs. For example, Alberta, Canada, has upgraded its safety laws to require employers to provide their workers with extensive job training in many areas. A training consultant is now developing training modules for a major training facility in Alberta, using FACE materials as the base for several modules. In addition, the reports are used as examples of actual incidents presented to classes.

The reports also are used by many safety training developers, professional trainers and institutions of higher learning. Education and training provides workers and their employers with heightened awareness of potential hazards and ways to reduce exposure and help prevent injury and death. Using NIOSH research findings as the basis for worker training materials is one important way to move research to practice.

Developing Worker-Friendly Guidance

NIOSH also translates scientific findings into worker-friendly guidance through the development of documents called Workplace Solutions. These publications are targeted primarily to workers and employers. They use the results of NIOSH research to describe hazards and prevention measures in a manner that is easy-to-understand, easy-to-access and easy-to-implement. Topics include:

- Preventing Injuries when Working with Hydraulic Excavators and Backhoe Loaders;*
- Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Powerlines;*
- Preventing Deaths and Injuries to Firefighters during Live-Fire Training in Acquired Structures;*
- Preventing Injuries when Working with Ride-On Roller/Compactors;*
- Preventing Injuries from Installing Drywall.*

To ensure that this information reaches the right audience, NIOSH works with organizations and associations that can provide mailing lists of workers or employers who are directly affected or that can help to distribute the information. For example, during 2000 and 2001, NIOSH received five reports of worker deaths associated with excavators or backhoe loaders as part of the FACE program. In response to these incidents, NIOSH (2003) developed a Workplace Solution titled *Preventing Injuries and Deaths when Working with Hydraulic Excavators and Backhoe Loaders*.

This publication is a nontechnical, concise version of research targeted to end users—SH&E practitioners, employers, supervisors, operators, foremen,

workers and worker representatives. The hazards and recommendations identified in this document apply to many manufacturers and types of construction equipment. For distribution purposes, Association of Equipment Manufacturers provided an international mailing list with more than 200 records. Several OSHA regional offices are also distributing copies. Positive feedback from manufacturers and operators of this machinery demonstrates the usefulness and application of this material.

Another example resulted from FACE investigations which demonstrated that operating cranes beyond their safe working lifting capacities may be the most significant risk for crane-related injury. NIOSH assembled a packet documenting crane-related injury risks and steps to prevent worker death and injury. This packet contained a sample of four fatality investigation reports and a page from the *NIOSH Alert: Preventing Electrocutions of Crane Operators and Crew Members Working Near Overhead Powerlines* (NIOSH, 1995).

The packet was mailed to approximately 4,600 crane rental and crane service establishments nationwide. Feedback indicates that the packet is being used for training purposes, toolbox talks and as support for safety program development. One crane rental company requested more than 100 copies in order to issue a copy with each crane rented.

In addition, OSHA's Training Institute includes copies in the training material for its crane safety courses. American Bureau of Crane Inspections requested 1,000 packets for use in its programs as well. One construction contractor who requested multiple copies wrote to the agency and said that the packet was "the most useful safety tool I ever received from the government. I had heard about the accidents, but didn't know the causes. I will circulate the publication among my employees who work with cranes. It will give us an opportunity to discuss crane safety using real-life examples."

Promulgating New Safety Policy

In February 2005, the most significant changes to U.S. child labor laws in decades went into effect. These changes have the potential to reduce young worker deaths and injuries associated with working on roofs, compactors and balers, driving and the manufacture of explosives. NIOSH played a critical role in the revised U.S. Department of Labor (DOL) regulations, providing input and recommendations on the proposed changes based on science. The agency's research was cited among the justifications for the rule changes.

As part of an ongoing DOL effort to promote positive, safe work experiences for youth while ensuring necessary and effective safety protections, DOL contracted with NIOSH to review available data and make recommendations for additional changes to regulations that prohibit 16- and 17-year-olds from performing especially hazardous work. DOL is actively considering these additional recommendations in the U.S. child labor policies.

Another example of NIOSH research affecting regulatory policy comes from the agency's state-based FACE program. In 1994, the New Jersey FACE program investigated a work-related fatality that involved a 20-year-old lifeguard who was electrocuted when he touched a water pump which was energized because of an electrical fault in the pump motor. Recognizing that similar conditions might exist at other public pools within the state, New Jersey Department of Health (1995) published a bulletin titled *Electrocution Hazard for Employees at Public Swimming Pools* and sent 3,200 copies to local health departments for distribution during their biannual swimming pool health inspections.

As a follow-up, NJFACE sent surveys to 270 swimming pool directors to determine whether their pools had been inspected and whether electrical hazards were identified. Seventy-three percent of respondents who had received the alert indicated that they had their swimming pools inspected—and 37% reported finding electrical problems.

In response to the lifeguard electrocution, Old Bridge, NJ, passed an ordinance in October 1994 requiring periodic inspections of swimming pools to help prevent electrocutions. During 1995, 15 of the town's 21 pools (71%) failed their initial inspection because they did not meet electrical requirements. In 1996, members of that state assembly and senate introduced bills modeled on the Old Bridge swimming pool ordinance. The NJFACE alert bulletin was cited in the bill's narrative to justify the new law.

After several years of discussion and modification, New Jersey Pool Law, PL1998c137, was signed into law in December 1999. The law requires pool owners to obtain a bonding and grounding certificate and an electrical certificate of compliance before opening the pool. As of January 2004, no additional work-related electrocutions have been reported at New Jersey swimming pools.

Developing or Modifying Guidelines & Voluntary Standards

To improve safety eyewear, NIOSH conducted research to develop several tools:

- a metric for evaluating coverage provided by safety eyewear;
- computer software to evaluate the coverage coefficient of digital eyewear models;
- a laboratory-based device for evaluating coverage coefficient.

One goal of this project was to introduce quantification of eyewear coverage into the U.S. consensus safety eyewear standard, ANSI Z87.1-2003, Occupational and Educational Personal Eye and Face Protection Devices consensus standard. The ANSI Z87 Accredited Standards Committee is charged with developing the national consensus standard for eye and face protection. As a result of this research, NIOSH representatives were invited to participate on the editorial committee that prepared the draft standard for final public review and full committee ballot.

This effort required preserving the foundation of the previous revision of the standard while incorporating new guidelines and modifications suggested by committee members and the public. For the first time, this standard applies high-velocity testing to prescription lenses and allows for a distinction between basic eye protection and high-impact protection. The revision took important steps toward improving the required level of protection of prescription safety eyewear by requiring high-velocity impact testing. By removing design restrictions and progressing toward a performance-based standard, new and innovative eyewear products can be developed that look stylish while providing enhanced worker protection. This results in both better protection and increased acceptance and use in the workplace.

Promoting New Safety & Health Practices

The widespread use of wireless communication services has fueled the construction of telecommunication towers to hold transmitting devices. Gross estimates of the risk for fatal injury suggest fatality rates 10 to 100 times the average across all industries (NIOSH, 2001b). Based on results of FACE investigations, NIOSH (2001b) developed an alert, *Preventing Injuries and Deaths from Falls during Construction and Maintenance of Telecommunication Towers*, with recommendations for prevention.

The agency also partnered with OSHA and the National Association of Tower Erectors (NATE) to develop and communicate effective injury prevention strategies. NIOSH provided research input to OSHA in the development of a safety checklist and revision of a compliance directive, both of which provide guidance on safe work practices in the construction and maintenance of telecommunication towers. NIOSH research also supported OSHA's efforts to develop a train-the-trainer course for compliance officers, contractors, tower erectors, tower owners, wireless service carriers and tower component manufacturers. The course includes information from FACE investigations of tower-related deaths. NATE also distributed the safety checklist and alert to its membership.

Because nearly 100 workers are killed and more than 20,000 are injured in the highway and street construction industry each year, NIOSH (2001a) published *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*. This publication is now in its fourth printing with more than 14,000 copies distributed to date.

Recommendations in the document have been incorporated into safety materials by other organizations as well. For example, the St. Paul and CNA insurance companies provide their clients with risk management recommendations taken directly from the document; the Dallas Area Road Construction Work Zone Task Force incorporated the document's prevention measures into a best practices guide; and the Laborers' Health and Safety Fund of North America added the prevention measures as an appendix to its 2003 *Highway Work Zone Safety Manual*.

The scientific occupational injury prevention community is now recognizing that researchers also must take responsibility for ensuring that the results of their research are transferred to or toward workplace application.

r2p in Action

Several projects exemplify the types of activities the r2p initiative is designed to promote and enhance.

Personal Dust Monitor for Assessing Particulate Exposure

In collaboration with manufacturers, labor and industry, NIOSH developed a personal dust monitor (PDM) for assessing coal miners' exposure to coal dust in underground coal mines. The PDM provides real-time exposure data during a work shift and warns of potential overexposures in time for mine operators to reduce exposures that might lead over time to the development of black lung disease.

Hand Wipe Method for Detecting Lead

This technology quickly and easily detects the presence of lead contamination on skin and on hard surfaces in industries where lead is produced or used to a limit of identification of 15 micrograms per sample. The method is patented and commercially available under the brand name Full Disclosure (available from SKC Inc.).

A follow-up invention is the Handwipe Removal Method for Toxic Metals. Hands Off! (proposed brand name) has been evaluated by NIOSH to effectively remove Pb and other toxic metals from the skin. The method involves a system of skin decontamination that is skin safe yet extremely effective at removing toxic elements such as Pb, nickel, cadmium and arsenic. This technology is patent-pending and currently available for commercial licensing.

Injury Prevention in the Commercial Fishing Industry

In partnership with an engineering firm, NIOSH helped to produce a detailed, easy-to-read booklet recommending and describing engineering measures on commercial crab fishing vessels to prevent injuries in this highly hazardous industry. More than 3,000 copies of the booklet have been distributed in the U.S. and abroad. The recommendations in the booklet resulted from NIOSH's partnerships with many stakeholders to develop practical interventions that address hazards posed by machinery, fishing equipment, and the physical design and layout of fishing vessels.

At the request of the American Road and Transportation Builders Association (ARTBA) and National Safety Council (NSC), NIOSH provided research and assistance in the development of an OSHA 10-hour program specifically for the road construction industry. Both ARTBA and NSC provide the program to their members and this course serves as the core component of the Northeast Regional Safety Academy's road construction safety training program.

Implementing New Technologies, Processes & Practices to Prevent Injuries

NIOSH collaborated with BJC Health System to evaluate a best practices back injury prevention program in a cohort of 1,728 nursing staff over a 6-year period. The intervention consisted of mechanical equipment to lift physically dependent residents, training on using the lifts properly, a zero-lift policy and a preexisting medical management program. The study demonstrated that a safe patient lifting program could achieve highly significant reductions in injuries, workers' compensation costs and lost and restricted workdays among healthcare workers while improving the quality of care delivered to patients and nursing home residents. The study further demonstrated that the reduction in workers' compensation expenses recovered the initial capital investment in equipment and training in less than 3 years.

In addition to publishing the results in the scien-

tific literature, a user-friendly document based on these results was developed to provide guidance for developing safe patient lifting programs in other healthcare facilities. The document, *Safe Lifting and Movement of Nursing Home Residents*, was distributed to 15,000 nursing homes in the U.S. to stimulate widespread replication of these significant findings (NIOSH, 2006). Agency personnel also contributed to a new textbook that will be used in training nursing students. This textbook represents a significant effort to change the way patient lifting has been taught in nursing schools for the past 100 years.

Partnerships Are Key to r2p

Each of these examples of effectively communicating and transferring workplace injury prevention research to practice depends on partnerships with key stakeholders. In this spirit of partnership for prevention, NIOSH and ASSE signed a partnership agreement in October 2003 through which the two groups are combining efforts and expertise to improve safety and health conditions in workplaces across the U.S. The goals of the agreement are to advance the protection of workers, promote best practices, and encourage employers to develop and use safety and health management programs and effective prevention strategies and technologies. Under the partnership agreement, NIOSH and ASSE are committed to working cooperatively to provide outreach, communication and professional development opportunities regarding occupational safety and health, and to facilitate the transfer and implementation of effective workplace injury prevention measures.

By sharing and exchanging injury research and providing strategies to transfer workplace injury prevention research to practice, we move closer to the shared goal of moving science to solutions for the prevention of work-related injuries and deaths. ■

References

- NIOSH. (1995). *NIOSH Alert: Preventing electrocutions of crane operators and crew members working near overhead powerlines* (NIOSH Publication No. 1995-108). Cincinnati, OH: Author.
- NIOSH. (2001a). *Building safer highway work zones: Measures to prevent worker injuries from vehicles and equipment* (NIOSH Publication No. 2001-128). Cincinnati, OH: Author.
- NIOSH. (2001b). *NIOSH Alert: Preventing injuries and deaths from falls during construction and maintenance of telecommunication towers* (NIOSH Publication No. 2001-156). Cincinnati, OH: Author.
- NIOSH. (2003). *NIOSH Workplace Solutions: Preventing injuries when working with hydraulic excavators and backhoe loaders* (NIOSH Publication No. 2004-107). Cincinnati, OH: Author.
- NIOSH. (2006). *Safe lifting and movement of nursing home residents* (NIOSH Publication No. 2006-117). Cincinnati, OH: Author.
- New Jersey Department of Health. (1995). *NJFACE Hazard Alert Bulletin: Electrocution hazard for employees at public swimming pools* (New Jersey Department of Health Publication No. 1995-G4580). Trenton NJ: Author.

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