Burden, Need and Impact: Safety in Construction

NECA PDC
Las Vegas
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May 23, 2017
National Institute for Occupational Safety and Health (NIOSH)

The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.
Organizational Chart of Federal Entities for Occupational Safety and Health

Regulation and Enforcement:
Department of Labor (DOL)
- Mine Safety and Health Administration (MSHA)
- Occupational Safety and Health Administration (OSHA)

Research and Prevention Recommendations:
Department of Health and Human Services (HHS)
- Centers for Disease Control and Prevention (CDC)
  - National Institute for Occupational Safety and Health (NIOSH)
The sole federal government organization charged with conducting occupational safety and health research
NIOSH Research Agenda

A national partnership effort to define and conduct priority research

Before 1996:

– National symposia on the leading causes of occupationally-related illness and injury
– Ten strategies

After 1996:

– National Occupational Research Agenda (NORA)
NORA 1996 to the Present

- **1996 NORA established**
  - Public-Private Framework setting OSH research agenda for the Nation
- **2006 Second Decade of NORA**
  - Organized research around 8 major industrial categories
  - Focus: research to practice
NIOSH Research and NIOSH-Funded Research

– Relevant to the problems of today’s workers and the workers of tomorrow

– Reflects science of the highest Quality

– Demonstrates measurable Impact
NORA 2006 - 2016

Organized around a *portfolio* of programs using North American Industry Classification System (NAICS)

Focused on impact using a research-to-practice (*r2p*) model

Independent scientific review by the National Academies
The National Occupational Research Agenda (NORA)

2016-2026
Third Decade of NORA
10 Sectors and 7 Cross-Sectors

Industry Sectors
Agriculture, Forestry and Fishing
Construction
Healthcare and Social Assistance
Manufacturing
Mining
Oil and Gas Extraction
Public Safety
Services
Transportation, Warehousing and Utilities
Wholesale and Retail Trade

Health & Safety Cross-Sectors
Cancer, Reproductive and Cardiovascular
Hearing Loss Prevention
Immune, Infectious & Dermal
Musculoskeletal Health
Respiratory Health
Traumatic Injury Prevention
Healthy Work Design and Well-being
## Third Decade of NORA

### NIOSH Core and Specialty Programs

#### First Decade Focus Areas

- Emerging Technologies
- Indoor Environment
- Mixed Exposures
- Organization of Work
- Special Populations at Risk
- 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

#### Core and Specialty Programs

<table>
<thead>
<tr>
<th>Authoritative Recommendations</th>
<th>Nanotechnology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate Change</td>
<td>Occupational Health Disparities</td>
</tr>
<tr>
<td>Direct Reading &amp; Sensor</td>
<td>Personal Protective Technologies</td>
</tr>
<tr>
<td>Technologies</td>
<td>Prevention through Design</td>
</tr>
<tr>
<td>Emergency Preparedness</td>
<td>Prevention through Design</td>
</tr>
<tr>
<td>Engineering Controls</td>
<td>Productive Aging and Work</td>
</tr>
<tr>
<td>Exposure Assessment</td>
<td>Safe, Skilled and Ready Workforce</td>
</tr>
<tr>
<td>Global Collaborations</td>
<td>Small Business Assistance</td>
</tr>
<tr>
<td>Health Hazard Evaluation</td>
<td>Surveillance</td>
</tr>
<tr>
<td>Motor Vehicle Safety</td>
<td>Workers Compensation Studies</td>
</tr>
</tbody>
</table>

Core activities, mandates, special emphasis areas and methodological approaches to research. Work with the appropriate Sectors and Cross-Sectors and participate in priority goal setting activities.
The BNI Method

We select the most important work to protect the workforce

We identify priorities to guide investments

We base priorities on the evidence of burden, need and impact.
BNI and Research Priorities

Burden
- Burden estimates drive the priority setting process
- Morbidity and mortality
- Disability and severity
- Economic costs
- Emerging Issues

Need
- Need identifies the most appropriate activities to conduct
- Stakeholder input
- NIOSH advantage
- Broad context fit

Impact
- Impact identifies activities with the greatest likelihood of success in preventing or reducing burden

Research Priorities
- BNI method selects priority research to guide investments to ensure that we do the most impactful work to protect the workforce
Number of work-related fatalities, by major industry, 2014\(^p\) (all employment)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>908</td>
</tr>
<tr>
<td>Transportation</td>
<td>768</td>
</tr>
<tr>
<td>Agriculture</td>
<td>568</td>
</tr>
<tr>
<td>Wholesale &amp;…</td>
<td>446</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>343</td>
</tr>
<tr>
<td>Mining</td>
<td>181</td>
</tr>
<tr>
<td>Information</td>
<td>33</td>
</tr>
<tr>
<td>Utilities</td>
<td>33</td>
</tr>
<tr>
<td>Finance</td>
<td>29</td>
</tr>
</tbody>
</table>

Note: P = preliminary
Number and rate of work-related fatalities in construction, 2003-2014\textsuperscript{P} (All employment)

Note: P = preliminary

Number and rate of nonfatal injuries resulting in days away from work in construction, 2003-2013 (private wage-and-salary workers)

Mission - NIOSH Construction Program

Preventing work-related illness, injury, disability, and death in the construction industry

Gathering information
Conducting research
Translating knowledge

Into products, solutions, and services tailored to meet construction needs.”
Program Structure and Focus Areas

NIOSH Construction Safety and Health Program

**Intramural Research**
- Basic Research
- Surveillance
- Methods Research
- Exposure Assessment
- Controls Development
- Applied Research
- Research to Practice

**National Construction Center**
- Industry Characterization
- Applied Research
- Industry Liaison
- Intervention
- Research to Practice

**Extramural Investigator-initiated Grants**
- Innovative Ideas
- Opportunities
- State Initiatives

**CPWR**
The Center for Construction Research and Training
Why Focus on Construction?

There were more fatal injuries in construction than any other industry in the United States in 2015, accounting for 21.4% of the nation’s 4,379 work-related deaths that year (BLS)
DRAFT National Construction Agenda, National Occupational Research Agenda (NORA)
Objective 1: Falls to a Lower Level - Eliminate falls to lower levels in construction
May 1, 2017 National Stand-Down Kick-off, the Wharf site, Washington, DC
Objective 2: Falls to the Same Level - Significantly reduce or eliminate slips, trips, and falls in construction
Improving Helmet Performance

Finite element (FE) model of head-brain-helmet complex
The DRAFT Objectives

Objective 3: Struck by –
Reduce fatal and serious injuries associated with struck-by incidents associated with objects, vehicles, and collapsing materials and structures in construction
Struck by/Caught in Between

46b. Primary sources of fatalities, road construction sites vs. all construction, 2008-2010 total

<table>
<thead>
<tr>
<th>Source</th>
<th>% of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles</td>
<td>50.2%</td>
</tr>
<tr>
<td>Heavy equipment</td>
<td>23.6%</td>
</tr>
<tr>
<td>Structures &amp; surfaces</td>
<td>37.2%</td>
</tr>
<tr>
<td>Parts &amp; materials</td>
<td>14.4%</td>
</tr>
<tr>
<td>Other</td>
<td>15.8%</td>
</tr>
</tbody>
</table>

46c. Fatal events involving vehicles and heavy equipment, by location, 2008-2010 total

<table>
<thead>
<tr>
<th>Event</th>
<th>% of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Struck by vehicle/mobile equip.</td>
<td>65.1%</td>
</tr>
<tr>
<td>Non-collision incident</td>
<td>24.2%</td>
</tr>
<tr>
<td>Caught in/struck by object/equip.</td>
<td>37.3%</td>
</tr>
<tr>
<td>Collision between vehicle/mobile equip.</td>
<td>31.4%</td>
</tr>
<tr>
<td>Other</td>
<td>30.7%</td>
</tr>
</tbody>
</table>

Road construction sites (175 deaths) Other construction sites (384 deaths) Streets & highways (401 deaths)
Nail Gun Safety

STRAIGHT TALK ABOUT NAIL-GUN SAFETY

Nail Gun Safety
A Guide for Construction Contractors

Seguridad con las pistolas de clavos
Guía para los contratistas del sector de la construcción
The DRAFT Objectives

Objective 4: Electrical –
Conduct research to address electrical safety issues on construction sites
Objective 5: Respiratory and dermal – Reduce the frequency of occupational disease caused by respiratory and dermal hazards in construction
Field Studies on Asphalt Paving

15 NIOSH technical reports of Partnership field studies over 11 years in 7 states

- Evaluated 50 different water-spray & ventilation control designs
- Most studies showed reductions in dust exposures
- All 15 NIOSH technical reports available online at: [http://www.cdc.gov/niosh/surveyreports/](http://www.cdc.gov/niosh/surveyreports/)
Best Practices Document and Field Guide

Describes 10 years of collaborative research
Highlights most successful engineering controls
Published March 2015
Objective 6: Hearing Loss –
Reduce occupational hearing loss in construction through a multifaceted research and outreach effort.

Nearly 50% of construction workers suffer hearing loss

HEARING LOSS IS PREVENTABLE
and you can do something about it...

Buy Quiet

Buy Quiet is an occupational health and safety initiative which encourages companies to purchase or rent quieter machinery as older machinery is replaced in order to reduce worker exposure to noise.

The program helps you comply with OSHA requirements, reduces the noise impact on the community, and encourages manufacturers to design equipment that is quieter. Most importantly, it reduces your risk of hearing loss.
Buy Quiet

A commitment to buying quieter equipment:

- Reduces your risk of hearing loss
- Reduces the noise impact on our community
- Encourages manufacturers to design quieter equipment

What You Can Do
Objective 7: Musculoskeletal disorders - Reduce the risk and burden of musculoskeletal disorders (MSDs) in construction.
Document is intended to help practitioners assess working posture for the prevention and control of occupational MSDs
Musculoskeletal Disorders

Rate of Sprains, Strains and Tears per 10,000 FTEs

<table>
<thead>
<tr>
<th>Industry</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Activities</td>
<td>9.6</td>
</tr>
<tr>
<td>Professional and business services</td>
<td>16.7</td>
</tr>
<tr>
<td>Other services</td>
<td>25.2</td>
</tr>
<tr>
<td>Leisure and hospitality</td>
<td>27.7</td>
</tr>
<tr>
<td>Information</td>
<td>27.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>31.6</td>
</tr>
<tr>
<td>All industries</td>
<td>35.4</td>
</tr>
<tr>
<td>Construction</td>
<td>36.3</td>
</tr>
<tr>
<td>Natural resources and mining</td>
<td>37.8</td>
</tr>
<tr>
<td>Education and health services</td>
<td>50.6</td>
</tr>
<tr>
<td>Trade, transportation and services</td>
<td>52.7</td>
</tr>
</tbody>
</table>
Reduce Manual Tasks by Automation

Automated vs. Manual Brick Laying

- Increased Productivity
- Reduced Crew Size
- Reduced Manual Handling of Paving Bricks
Objective 8: Workers at disproportionate risk - Conduct research to eliminate disproportionate risks in construction.
Overlapping Vulnerabilities: The Occupational Health and Safety of Young, Immigrant Workers in Small Construction Firms

May 2015

A joint effort with the American Society of Safety Engineers (ASSE)

PIs: Mike Flynn and Tom Cunningham, NIOSH

“overlapping vulnerabilities” = the combination of risk factors

Change in data collection

Identify and significantly improve their outreach and intervention efforts
Overlapping Vulnerabilities: The Occupational Health and Safety of Young, Immigrant Workers in Small Construction Firms

EXAMPLES OF POTENTIAL BARRIERS TO IMPROVING OSH OUTCOMES

**HISPANIC IMMIGRANTS**
- Language barriers
- Fear of reprisals
- Limited knowledge of OSH laws

**SMALL BUSINESSES**
- Fewer resources such as safety training and equipment
- Limited time for OSH activities

**YOUNG WORKERS**
- Discomfort voicing concerns
- Age power differential

Overlapping vulnerabilities may intensify the risk for occupational injury and illness.
Overlapping Vulnerabilities: The Occupational Health and Safety of Young, Immigrant Workers in Small Construction Firms

- Construction industry
- Working in small businesses
- Young age
- Born outside of the United States
Objective 9: Small business – Reduce the number of illnesses, injuries, and fatalities occurring in small construction firms (employing 20 or fewer employees).
Objective 10: Motor Vehicle Safety in Construction – Significantly reduce or eliminate work-related motor vehicle incidents by workers in the U.S. construction industry.
NIOSH Fact Sheet: Motor Vehicle Crashes

Preventing work-related motor vehicle crashes

You can protect your employees and others on the road from being hurt or killed in motor vehicle crashes

This fact sheet recommends ways you can keep workers safe when driving or riding in a motor vehicle on the job. It outlines components of a successful motor vehicle safety program. It ends with a checklist that you can use to implement the recommendations.

Motor vehicle crashes are the **leading cause of death** among workers in the U.S. 18,716 work-related crash fatalities between 2003 and 2012

- 12,458 deaths in single- or multiple-vehicle crashes on public roadways
- 2,942 deaths in crashes that occurred off the highway or on industrial premises
- 3,316 pedestrian worker deaths as a result of being struck by a motor vehicle

March 2015
Objective 11: Emerging Issues

- Nanotechnology
- Drones

Multi-Attachment Non-Tethered Industrial System (MANTIS)
Objective 12: Extreme Temperatures – Reduce the likelihood of temperature extreme incidents in construction and develop intervention strategies to protect these workers.
Figure 4-1. Examples of heat-related illness risk factors
The DRAFT Objectives

Objective 13: Prevention through Design (PtD) - Increase the use of “prevention through design (PtD)” approaches to prevent or reduce safety and health hazards in construction.
Prevention through Design (PtD)

Designed for owners, contractors, & workers, Construction Solutions is a database of work hazards, & practical control measures to reduce or eliminate hazards.

Solution: Considering Roof Parapets During the Design Phase

Description:
The proper design of roof parapets at a specific project is a critical process that addresses worker exposure to fall hazards. Roof parapets are the parts of the roof that prevent falls from flat low-sloped roofs. Having parapets eliminates the need for additional fall arrest system equipment, temporary barricades, or signs during the design phase.

Parapet walls may also qualify as guardrails. OSHA requires that roof parapets be at least 39 inches tall and capable of withstanding a 200-pound load applied within 2 inches of the top of the wall or parapet along the top edge.

Diagram by Nicholas Tymoczko and John Garabedian. Diagram is the strength requirement needed to be able to support the weight of a person.

Alternatively, temporary guardrall systems can be installed when installing roof anchors.

Solution: Designing Roofs with Permanent Roof Anchors

Description:
Designing roofs that include permanent roof anchors is a process that addresses worker exposure to potential fall hazards for roof maintenance of buildings. Installing permanent roof anchors provides a safe means for temporary work to be performed on a roof.

The three components to a personal fall arrest system of this design solution specifically includes the anchorage design, the roof and identification of the anchors on the roof, and the connection of the system to the roof for connecting personal fall arrest system equipment to the roof edge.

There are many different methods of securing roof anchors. It is recommended to follow all guidelines when installing roof anchors.

Solution: Installing Permanent Tie-in Anchor Systems During the Design Phase

Description:
Installing permanent tie-in anchor systems is a process that addresses worker exposure to potential fall hazards for roof maintenance of buildings. The system permanently attached to the inner structural member of the building's non-structural steel structure. Installing permanent anchor systems on day(s) before work begins can save lives during the design phases of a project.

Permanent tie-in anchor systems are, such as those that provide a metal anchor bracket that can be bolted or riveted to the inner structural member of the building's non-structural steel structure. Installing permanent anchor systems on day(s) before work begins can save lives during the design phases of a project.

Guardrall systems are the primary means of fall protection in construction and are required by OSHA, under 1926.502(b)(1), for unprotected sides or edges that are 6 feet or more above a lower level. It is a passive form of fall protection that is a physical barrier that prevents workers from falling to lower levels. A guardrail consists of a top rail at a height of 42 inches (+/−3 inches) above the walking/working level and a midrail at a height of 21 inches above the walking/working level.

Guardrail requirements, under 29 CFR 1926.502(b)(1), guardrail systems to withstand, without failure, a force of 200 pounds applied within 2 inches of the top edge, in any outward or downward direction.

During the design of the building, guardrail systems can be specified around floor openings or exposed open sides which make it easy for contractors to install temporary guardrails during the construction phase. The sockets can also be used for permanent railings.

Solution: Considering Cast-in Sockets for Guardrails and Handrails During the Design Phase

Description:
The specification of temporary or permanent guardrail systems around floor openings or exposed open sides is a prevention through design (PtD) process that addresses worker exposure to fall hazards during the design phases of a project. Having guardrail systems installed could minimize, or even eliminate, the need for additional fall arrest roof anchors and related personal fall arrest equipment, temporary barricades, or signs during operation and maintenance tasks.

Guardrall systems are the primary means of fall protection in construction and are required by OSHA, under 1926.502(b)(1), for unprotected sides or edges that are 6 feet or more above a lower level. It is a passive form of fall protection that is a physical barrier that prevents workers from falling to lower levels. A guardrail consists of a top rail at a height of 42 inches (+/−3 inches) above the walking/working level and a midrail at a height of 21 inches above the walking/working level.

Additionally, OSHA requires, under 29 CFR 1926.502(b)(3), guardrail systems to withstand, without failure, a force of 200 pounds applied within 2 inches of the top edge, in any outward or downward direction.

During the design of the building, guardrail systems can be specified around floor openings or exposed open sides which make it easy for contractors to install temporary guardrails during the construction phase. The sockets can also be used for permanent railings.

Explore Solutions For:
- Fall from heights
  - Engineering control
    - Guardrail Clamp System
    - Guardrails
    - Hook Covers
  - Administrative control
    - Building Information Modeling (BIM) for Safety Planning
    - PPE
      - Personal Fall Arrest Systems
PtD Published Manuscripts

www.asse.org/professionalaffairs/ptd

www.cdc.gov/niosh/programs/ptdesign/pubs.html
PtD Websites

NIOSH Prevention through Design websites
http://www.cdc.gov/niosh/programs/PtDesign/

www.cdc.gov/niosh/topics/PtD/

PtD wiki
http://www.orcehs.org/wiki/display/orcehs/PtD+Case+Studies

E-mail: preventionthroughdesign@cdc.gov
The DRAFT Objectives

Objective 14: Research to Practice (r2p) –
Build capacity for and a body of research on effective translation research and r2p strategies to advance the use of evidence-based interventions in construction to reduce construction injuries and illnesses.
Objective 15: Work Organization –
Improve conditions in the construction industry by studying safety culture and safety climate and how work is organized through identification, data collection and data monitoring of contracting, management practices, insurance, aging, the use of leading indicators, and employment relationships, as well as, conducting research on and implementing effective intervention strategies.
Construction Safety Culture and Safety Climate

June 11-12, 2013 Workshop

Safety Culture and Safety Climate in Construction: Bridging the Gap Between Research and Practice

Objective 16: Surveillance –
Reduce occupational safety and health hazards in the construction industry through proactive surveillance activities and research.
Objective 17: Training – Research to increase the reach, scope, and effectiveness of training in construction
FREE Apps! ...
Ladder Safety Application for Smart Phones

The free APP quickly and easily positions extension ladder at correct angle

Graphic-oriented aid

Inclination indicator

Great! 75.5°
NIOSH Sound Level Meter App

The NIOSH Sound Level Meter mobile application is a tool to measure sound levels in the workplace and provide noise exposure parameters to help reduce occupational noise-induced hearing loss.

Key Benefits

- Raises workers’ awareness about their work environment
- Helps workers make informed decisions about the potential hazards to their hearing
- Serves as a research tool to collect noise exposure data
- Promotes better hearing health and prevention efforts
- Easy to use

Download the free app today

Project Officer: Chuck Kardous, DART
Thank you!

Christine Branche, Ph.D., FACE  
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NIOSH Directory of Construction Resources  
www.cdc.gov/niosh/construction/  
Twitter  
http://twitter.com/NIOSHConstruct

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