

A Smarter National Surveillance System for Occupational Safety and Health in the 21st Century

The NIOSH Plan to Implement the National Academies'
Program Evaluation Recommendations

December 2019

Table of Contents

Acronyms	1
Introduction	4
Background	5
Table 1: National Academies' Recommendations	5
Recommendation Categories	7
Table 2: Categories of Recommendations for NIOSH	7
NIOSH Priorities for Short term and Long term Implementation	8
Short term Strategy:	8
Long term (Sustained) Strategy:	9
Appendix 1: The NIOSH Response to National Academies' Recommendations (A–Q Full Listing)	11
References	42

Acronyms

AASCIF	American Association of State Compensation Insurance Funds
ABLES	Adult Blood Lead and Epidemiology Surveillance
ACOEM	American College of Occupational and Environmental Medicine
Ag Centers	Agricultural Health and Safety Centers
AHRQ	Agency for Healthcare Research and Quality
AMIA	American Medical Informatics Association
AoU	All of Us Research Program
BLS	Bureau of Labor Statistics
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CEHD	Chemical Exposure Health Data
CIO	Center, Institute, Office
CMS	Centers for Medicare and Medicaid Services
CSELS	Center for Surveillance, Epidemiology, and Laboratory Services
CSTE	Council of State and Territorial Epidemiologists
DoE	Department of Energy
DOERHS-HC	The Defense Occupational and Environmental Health Readiness System, Hearing Conservation
DOERHS-IH	The Defense Occupational and Environmental Health Readiness System, Industrial Hygiene
DOL	Department of Labor
EHR	Electronic Health Record
EIS	Epidemic Intelligence Service
Epi-X	Epidemic Information Exchange
ERC	Education and Research Center
HHS	U.S. Department of Health and Human Services
HL7	Health Level Seven
HSOII	Household Survey on nonfatal Occupational Injuries and Illnesses
ICD	International Classification of Disease

IIU	Informatics Innovation Unit
I/O	Industry and Occupation
IMIS	Integrated Management Information System
IOM	Institute of Medicine
ISA	Interoperability Standards Advisory
IT	Information Technology
MSHA	Mine Safety and Health Administration
MSIS	MSHA Standardized Information System
NA	National Academies
NAICS	North American Industry Classification System
NCCI	National Council on Compensation Insurance
NCEH	National Center for Environmental Health
NCIPC	National Center for Injury Prevention and Control
NEISS-Work	National Electronic Injury Surveillance System-Work Supplement
NHANES	The National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
NIH	National Institute of Health
HIMSS	Health Information Management and Systems Society
NIOCCS	The NIOSH Industry and Occupation Computerized Coding System
NIOSH	National Institute for Occupational Safety and Health
NMI	NNDSS Modernization Initiative
NNDSS	National Notifiable Diseases Surveillance System
NRC	Nuclear Regulatory Commission
ODH	Occupational Data for Health
OEP	Office of Extramural Programs
OHBWC	Ohio Bureau of Workers' Compensation
OIICS	Occupational Injury and Illness Classification System
OIS	Occupational Safety and Health Administration Information System
ONC	Office of the National Coordinator for Health Information Technology
ORS	Occupational Requirements Survey
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
REIRS	The Radiation Exposure Information and Reporting System

RTW	Return to Work
SCG	Surveillance Coordination Group
SOC	Standard Occupational Classification
SOII	Survey of Occupational Injuries and Illnesses
UMLS	Unified Medical Language System
USCDI	U.S. Core Data for Interoperability
WC	Workers' Compensation
WCIO	Workers' Compensation Insurance Organizations
WCRI	Workers' Compensation Research Institute

Introduction

The Occupational Safety and Health Act of 1970 established the National Institute for Occupational Safety and Health (NIOSH) as part of a mandate to assure “every man and woman in the Nation safe and healthful working conditions and to preserve our human resources.” NIOSH later became part of the Centers for Disease Control and Prevention (CDC) in the U.S. Department of Health and Human Services (HHS). NIOSH studies occupational safety and health through scientific research, transforming this research into cost-effective, global work practices. NIOSH works with public and private sectors to make work safer, healthier, and more productive for workers, employers, and the nation. NIOSH has operations in Anchorage, Alaska; Atlanta, Georgia; Cincinnati, Ohio; Denver, Colorado; Morgantown, West Virginia; Pittsburgh, Pennsylvania; Spokane, Washington; and Washington, D.C. There are about 1,080 full-time employees, including Commissioned Corps Officers, and about 1,109 fellows and contracted employees from diverse fields including epidemiology, medicine, nursing, industrial hygiene, safety, psychology, chemistry, statistics, economics, engineering, health communication, and others.

The [NIOSH strategic goals](#) during 2016–2020 include Goal 1, which specifically addresses the need for occupational safety and health surveillance: Track work-related hazards, exposures, illnesses and injuries for prevention. The NIOSH Surveillance Program coordinates surveillance activities across NIOSH, emphasizing collaboration and communication while avoiding overlap between surveillance activities at its multiple locations. More information about the NIOSH Surveillance Program is available on the [Worker Health Surveillance](#) webpage.

NIOSH continues to build relationships and partnerships with other federal agencies, the states, private industry, and the public health community to access relevant sources of surveillance data. NIOSH is also currently working to meet the objective of providing needed surveillance data to its various internal [programs](#) organized by industry sector and health and safety cross-sector and to the entire occupational safety and health community. This approach includes use of biomedical informatics to reach the long term goal to incorporate industry and occupation (I/O) into health surveys, case reporting, and ultimately into electronic health records (EHRs) and other sources of data from the healthcare delivery system. This includes a key objective to better communicate findings to facilitate future research and interventions. The NIOSH Surveillance Program plans to more fully incorporate biomedical informatics approaches as we 1) leverage existing surveys and data systems managed by other agencies; 2) incorporate I/O into existing surveys, case reports, data systems, and EHRs; 3) improve the capacity and accuracy of I/O auto coders; 4) build state occupational health surveillance capacity; and 5) accelerate communication for prevention.

Background

NIOSH, the Bureau of Labor Statistics (BLS), and the Occupational Safety and Health Administration (OSHA) jointly asked the National Academies (NA) to conduct a study to address the need for a more coordinated, cost-effective approach for U.S. occupational safety and health surveillance. Each of the federal agencies provided the NA Committee with extensive information on the current status of their surveillance activities. The NA Committee deliberated for over a year to produce the *Consensus Study Report, A Smarter Surveillance System for Occupational Safety and Health in the 21st Century*. The report contained 17 recommendations as listed in Table 1, with 13 recommendations specifically naming NIOSH as the lead.

Table 1: National Academies' Recommendations

Recommendation A** – BLS and OSHA should collaborate to enhance injury and illness recording and the Survey of Occupational Injuries and Illnesses (SOII) to achieve more complete, accurate, and robust information on the extent, distribution, and characteristics of work-related injuries and illnesses and affected workers for use at the worksite and at national and state levels.

Recommendation B – NIOSH, working with the state occupational safety and health surveillance programs and across divisions within the agency, should develop a methodology and coordinated system for surveillance of both fatal and nonfatal occupational disease using multiple data sources.

Recommendation C – NIOSH should lead a collaborative effort with BLS, OSHA, the states, and other relevant federal agencies to establish and strengthen state-based occupational safety and health (OSH) surveillance programs.

Recommendation D** – BLS should place priority on implementing its plan for a household survey of nonfatal occupational injury and illnesses (HSOII)

Recommendation E ** – OSHA, in conjunction with BLS, NIOSH, state agencies, and other stakeholders, should develop plans to maximize the effectiveness and utility of OSHA's new electronic reporting initiative for surveillance.

Recommendation F – NIOSH, with assistance from OSHA, should explore and promote the expanded use of workers' compensation data for occupational injury and illness surveillance and the development of surveillance for consequences of injury and illness outcomes, including return to work and disability.

Recommendation G – HHS should designate industry and occupation as core demographic variables collected in federal health surveys, as well as in other relevant public health surveillance systems, and foster collaboration between NIOSH and other CDC centers in maximizing the surveillance benefits of including industry and occupation in these surveys and surveillance systems.

Recommendation H – NIOSH, in consultation with OSHA, should place priority on developing a comprehensive approach for exposure surveillance.

Recommendation I – NIOSH should coordinate with OSHA, BLS, and other relevant agencies to measure and report, on a regular basis, the economic and health burdens of occupational injury and disease at the national level.

Recommendation J – NIOSH should build and maintain a robust internal capacity in biomedical informatics applied to OSH surveillance.

Recommendation K – NIOSH should work with the National Library of Medicine to incorporate core OSH surveillance terminologies, including those for industry and occupation, into the Unified Medical Language System (UMLS).

Recommendation L – NIOSH should lead efforts to establish data standards and software tools for coding and using occupational data in electronic health records.

Recommendation M – NIOSH and BLS, working with other relevant agencies, academic centers, and other stakeholders, should coordinate and consolidate, where possible, efforts to develop and evaluate state-of-the-art computational and analytical tools for processing free text data found in OSH surveillance records of all types.

Recommendation N – To identify emerging and serious OSH injuries, illnesses, and exposures in a timely fashion, NIOSH (in coordination with OSHA, BLS, and the states) should develop and implement a plan for routine, coordinated, rapid analysis of case-level OSH data collected by different surveillance systems, followed by the timely sharing of the findings.

Recommendation O – To promote and facilitate the use of surveillance information for prevention, and to present more comprehensive information on the extent, distribution, and characteristics of OSH injuries, illnesses, and exposures, NIOSH (in coordination with and input from OSHA, BLS, and the states) should establish a coordinated strategy and mechanism for timely dissemination of surveillance information.

Recommendation P – NIOSH, OSHA, and BLS should work together to encourage education and training of the surveillance workforce in disciplines necessary for developing and using surveillance systems, including epidemiology, biomedical informatics, and biostatistics.

Recommendation Q** (meta-recommendation) – The Secretary of HHS, with the support of the Secretary of Labor, should direct NIOSH to form and lead a coordinating entity in partnership with OSHA, BLS, and other relevant agencies. The coordinating entity should do the following:

Develop and regularly update a national occupational safety and health surveillance strategic plan that is based on well-articulated objectives.

Coordinate the design and evaluation of an evolving national system of systems for OSH surveillance and for the dissemination of surveillance information provided by these systems.

Publish a report on progress toward the strategic plan's implementation at least every 5 years, documenting advances toward achieving a 21st Century Smarter Occupational Safety and Health (OSH) Surveillance System; and

Engage partners, including other federal health statistics agencies, state agencies with OSH responsibilities, and stakeholders.

**NIOSH is not the lead agency for this recommendation.

Recommendation Categories

The NA committee created four major categories of recommendations: 1) prioritize and coordinate OSH surveillance, 2) improve data collection, 3) expand biomedical informatics use and capabilities, and 4) strengthen data analysis and information dissemination for prevention. The majority of the recommendations listed in Table 1 are related to NIOSH's contribution and potential contributions and were assigned into the four categories as listed below in Table 2.

Table 2: Categories of Recommendations for NIOSH

1: Prioritize and coordinate OSH surveillance
<ul style="list-style-type: none">• Recommendation B• Recommendation C• Recommendation G• Recommendation J• Recommendation P
2: Improve data collections
<ul style="list-style-type: none">• Recommendation F• Recommendation H
3: Expand biomedical informatics use and capabilities
<ul style="list-style-type: none">• Recommendation G• Recommendation J• Recommendation K• Recommendation L• Recommendation M
4: Strengthen data analysis and information dissemination for prevention
<ul style="list-style-type: none">• Recommendation I• Recommendation N• Recommendation O

After release of the NA report, a NIOSH implementation workgroup was established and divided into four corresponding sub-groups to address these recommendation categories. There were two recommendations (G and J) that overlapped in two categories: Prioritize and

coordinate OSH surveillance and Expand biomedical informatics use and capabilities. The two workgroups collaborated on a single response for recommendations G and J.

NIOSH Priorities for Short term and Long term Implementation

For simplicity, the full recommendations and NIOSH's responses are presented in [Appendix 1](#) in alphabetical order. The NA report recommendations guide an aspirational and visionary strategy to achieve an overall better and more comprehensive surveillance system. This is a long term effort (within the next ten years), certainly worthy of pursuing. However, NIOSH also requires an achievable, shorter term approach (within the next five years) to meet the needs of its public health, industry, labor, and insurer stakeholders to provide the most useful information for risk reduction strategies while simultaneously working within the Institute's available resources.

Using the information presented in the NA report, NIOSH will have a two-pronged approach to answer these questions:

Short term: What can NIOSH do now to make the surveillance data currently available more useful to government entities (including states), industry, labor, insurers, employers, and workers? It is critical that NIOSH engage with all its stakeholders to best determine how surveillance information can drive practical interventions to reduce risk in the workplace.

Long term: What are the necessary steps to address the foundational and fundamental aspects of a more comprehensive occupational safety and health surveillance system for the United States? This should be done in partnership with OSHA, BLS, and public health partners.

Short term Strategy (within the next five years):

For NIOSH to make currently available surveillance data more useful in reducing risk and improving outcomes for worker health and safety, NIOSH outlines the following priorities:

Engagement with Stakeholders: Meet with stakeholders to include NORA Councils, government entities (including states), industry, labor, insurers, employers, and workers to seek their input on meeting their risk reduction needs through occupational safety and health surveillance information. This will inform both short term and long term strategies.

Biomedical Informatics: Recommendations from the NA related to biomedical informatics were very useful in solidifying this issue as critical in moving forward. The NIOSH Associate Director for Information Technology will recruit the informatics engineering expertise required. The NIOSH Surveillance Program will identify appropriate subject matter experts and communications experts. These groups will establish a team to integrate and coordinate current systems and formulate a unified approach. Similar capacity building in informatics should be encouraged within the extramural public health community. (Recommendation J)

Messaging: The first activity of the team described in the last paragraph will be to present current NIOSH surveillance information in a cohesive, flexible, and usable way for our stakeholders. (Recommendations I, J, O)

Long term Strategy (within the next ten years):

As outlined in the NA Recommendations, numerous steps are needed to build a more integrated and comprehensive occupational safety and health surveillance system. It will require NIOSH to work with all its partners, including OSHA and BLS. Below are some of NIOSH's highest priorities:

Biomedical Informatics Capacity Building: The key to success for most of the recommendations is increasing organizational capacity in biomedical informatics, building on activities described in our short term strategy, NIOSH will develop curricula for its staff and extend this effort to working with NIOSH funded Education and Research Centers. The approach to capacity building is described under Recommendations J, M, and P but resonates throughout much of the NIOSH plan.

Incorporating Industry and Occupation into Surveillance Systems: NIOSH will continue to focus its efforts on working with other CDC centers and other federal programs to encourage permanent inclusion of I/O in specific surveys and data collections that have the best potential to be informative and useful for surveillance. This work will continue to be conducted in partnership with states and other federal centers or organizations. Below are three areas of focus for this priority. (Recommendation G)

- a. NIOSH Industry and Occupation Computerized Coding System (NIOCCS): NIOCCS is a valuable tool that allows computer coding of text-based industry and occupation information. The tool allows analysis of data systems that were not previously available. We will continue to improve the tool including using new technologies such as machine learning techniques, which is already underway. (Recommendations G, M)
- b. Electronic Health Records: EHRs are a potentially important future source of detailed surveillance data for morbidity, mortality, and economic impact of work-related conditions. NIOSH has made incorporating information about work into these records a feasible goal by developing necessary vocabulary and standards to support inclusion of structured data including industry and occupation into electronic health systems. Much work has been done to advance the inclusion of occupational health data into EHRs and this remains a high priority for the NIOSH Surveillance Program. (Recommendation L)
- c. Partnerships: We will continue to partner with CDC and other government agencies to incorporate industry and occupation into surveillance systems. (Recommendation L)

Workers' Compensation Data: New technologies allow the use of workers' compensation data for surveillance and prevention purposes. This priority area includes three focus areas:

- a. **Exposure Surveillance:** Extensive exposure data exists in workers' compensation records. However, assembling it into a surveillance system remains a challenge. Workers' compensation insurers are some of the largest collectors of occupational exposure data. New technologies provide the potential for analysis of these data to help identify priority hazards and trends over time. (Recommendation H)
- b. **Return to Work:** The NIOSH Center for Workers Compensation Studies is poised to examine factors related to the return-to-work of injured workers to reduce the overall burden of work-related disability, including quality and cost of care. (Recommendation F)
- c. **State Capacity:** Increase the capacity of states to evaluate and use their workers' compensation data for prevention. (Recommendation F)

Increase Surveillance Capacity of State Health Departments: State health departments are extremely effective partners in state occupational health surveillance systems and their activities augment several federal surveillance systems. Based on the availability of funds, a long-range NIOSH vision of a comprehensive surveillance research program would be to incrementally fund more states with core capacity to conduct surveillance of occupational injuries, diseases, and hazards. This would contribute to state and local prevention efforts, as well as to national data. (Recommendation C)

Coordinate with OSHA and BLS: 1) Meet with BLS and OSHA to discuss possible synergies for occupational surveillance; and 2) encourage the BLS to move forward with the Household Survey. (Recommendation D)

Appendix 1: The NIOSH Response to National Academies' Recommendations (A–Q Full Listing)

Recommendation A:

BLS and OSHA should collaborate to enhance injury and illness recording and the SOII to achieve more complete, accurate, and robust information on the extent, distribution, and characteristics of work-related injuries and illnesses and affected workers for use at the worksite and at national and state levels.

NIOSH is not the lead agency for this recommendation.

Recommendation B: Prioritize and coordinate OSH surveillance.

NIOSH, working with state occupational safety and health surveillance programs and across divisions within the agency, should develop a methodology and coordinated system for surveillance of both fatal and nonfatal occupational disease using multiple data sources.

There is no single, coordinated occupational disease surveillance system in the United States. Instead, there is an evolving set of systems, with different objectives. The major data sources for occupational disease surveillance include

- Case reports (e.g., silicosis, acute pesticide-related illness, acute and infectious diseases)
- Individuals, i.e., workers (e.g., through participation in national health surveys with I/O components)
- Employers (e.g., insurance claims, mandated reporting, SOII)
- Disease registries
- Vital records (e.g., death and birth certificates).

Unlike injury surveillance, chronic disease surveillance has additional challenges such as a lag time for many chronic conditions and multiple risk factors (work and nonwork related).

NIOSH, in collaboration with state occupational safety and health surveillance programs and across the Institute, has developed an approach to occupational disease surveillance, using existing data sources:

- Death certificates (collaboration with states and National Center for Health Statistics for I/O coding)
- National health surveys (e.g., employment information from National Health Interview Survey (NHIS) and the Behavioral Risk Factor Surveillance System (BRFSS))
- Medical monitoring programs (e.g., Coal Workers' Health Surveillance Program)

- Infectious disease surveillance (conditions possibly of occupational origin in National Notifiable Diseases Surveillance System (NNDSS))
- State-based Occupational Safety and Health surveillance (e.g., sentinel surveillance in some states)

Some of these data sources capture cases of specific conditions that are 100% attributable to work (e.g., coal worker's pneumoconiosis), while most are used to make inferences about occupational associations with multifactorial health conditions such as cancer and heart disease.

Sub-recommendation B1:

NIOSH should combine information from the existing focused occupational disease surveillance systems—e.g., Adult Blood Lead and Epidemiology Surveillance (ABLES), pesticide illness, silicosis surveillance, and National Occupational Respiratory Mortality System (NORMS) and mesothelioma from cancer registries and other relevant occupational health indicators—to provide a more comprehensive annual report on the extent of occupational illness morbidity and mortality that can be released in conjunction with information from the SOII. Methods for extrapolating from available data to generate national estimates should be explored.

The plan for improving dissemination of surveillance information is provided in the response to Recommendation O.

Sub-recommendation B2:

To enhance surveillance of occupational lung disease, NIOSH should require all B readers to report all chest radiographs interpreted to be positive for all types of pneumoconiosis.

NIOSH does not have authority to require this action from B readers. However, NIOSH provided assistance to the Council of State and Territorial Epidemiologists (CSTE) to develop an electronic case reporting guide for silicosis that allows states to choose an International Labour Organization classification of a chest radiograph consistent with pneumoconiosis as a trigger code for case reporting. NIOSH is working to develop a Message Mapping Guide for silicosis, which would allow states to notify CDC of these cases since silicosis is included on the list of conditions tracked through CDC's NNDSS.

Sub-recommendation B3:

Increased collaboration between NIOSH and CDC infectious disease surveillance programs, with improved collection of occupational information, will be important to improve documentation of endemic and epidemic infectious disease related to work.

NIOSH will continue work that has already begun with CDC's Center for Surveillance, Epidemiology and Laboratory Services (CSELS) and other CDC centers on part of the NNDSS Modernization Initiative (NMI) to include I/O as standard data, coded using NIOCCS, for all

conditions reported in NNDSS. Details of this plan are provided in the response to Recommendation G.

Sub-recommendation B4:

Gaps identified in the occupational illness surveillance system will need to be addressed through future developments that may involve: New or modified state regulations, requiring close coordination with the states, many of which have already promulgated reporting regulations; Inference of occupational disease burden and trends that result from enhanced exposure assessment; Updating the list of occupational sentinel health events, establishing additional criteria for establishing a link between workplace exposures and common diseases.

NIOSH and other federal OSH partners will continue to meet regularly with states to discuss coordination for occupational disease surveillance regarding the impact of modifications of state regulations and burden estimates as discussed under Recommendation I.

Sub-recommendation B5:

Action on recommendations that address the inclusion of occupational information in medical records, federal health surveys and public health surveillance systems, and automated coding of the industry and occupation information will be important for ensuring the optimal implementation over time of this recommendation.

This sub-recommendation overlaps with Recommendations G, J, L, and M; therefore, it will be addressed through the plans described in those sections.

Recommendation C: Prioritize and coordinate OSH surveillance.

NIOSH should lead a collaborative effort with BLS, OSHA, the states, and other relevant federal agencies to establish and strengthen state-based OSH surveillance programs.

The [NIOSH Surveillance Program](#) acknowledges that states have a vital role to play in the surveillance of occupational injuries, diseases, and hazards. In 2015, the Institute increased funding to support 26 state occupational health surveillance programs through June 2020.

NIOSH supports the following types of state surveillance programs:

- **Fundamental:** Collect, analyze, interpret a minimum of 15–20 occupational health indicators.
- **Fundamental-Plus:** Adds a priority evidence-based topic for in-depth follow-up and an area for focused intervention activities.
- **Expanded:** Adds targeted surveillance and in-depth follow-up on selected Priority Focus Areas.

The current portfolio consists of 8 Fundamental, 11 Fundamental-Plus, and 7 Expanded Surveillance Programs.

Currently

- NIOSH meets annually with OSHA, BLS, and the states. NIOSH also has regional meetings with the states, regional OSHA offices, and the NIOSH-funded Education and Research Centers (ERCs) and Agricultural Health and Safety Centers (Ag Centers).
- NIOSH and CDC's National Center for Injury Prevention and Control (NCIPC) each fund injury surveillance and capacity building programs in 21 states. In 2016, the NIOSH and NCIPC Directors sent letters to the health commissioners in these states strongly encouraging collaboration between these programs.
- Primary roles and responsibilities for these implementation activities are distributed across the NIOSH Surveillance Program, Surveillance Coordination Group (SCG), the Office of Extramural Programs (OEP), other internal partners, and external partners. The SCG has the responsibility to build and maintain clear communication and coordination pathways between these groups.

A long-range NIOSH vision of a comprehensive Surveillance Program would include incrementally funding more states with core capacity to conduct surveillance of occupational injuries, diseases, and hazards. This would help state and local prevention efforts, as well as contribute to national data concerning magnitude, trend, and distribution for morbidity and mortality. The scope of this approach depends upon available resources.

Sub-recommendation C1:

OSH Agency Collaboration within States: NIOSH, BLS, and OSHA should actively encourage and promote collaboration among their programs in the states to reflect the national commitment to interagency effectiveness for OSH surveillance and leverage surveillance and prevention expertise across agencies. This should include sharing data and taking advantage of unique state-level data sets and case-based surveillance capacities to identify and respond to emerging occupational safety and health hazards and conditions.

NIOSH will continue to encourage collaboration among OSH state programs to address state and regional OSH needs such as a recent collaboration between Minnesota, Iowa, and Wisconsin for preventing serious agricultural injury in the tri-state area.

Sub-recommendation C2:

Public Health Agency Collaboration within States: NIOSH and other CDC centers that support state-based surveillance and prevention activities should promote collaboration among their state-level programs to monitor and address public health problems of shared concern, such as violence, asthma, infectious disease, traffic safety, and health inequities among vulnerable population groups.

All NIOSH-funded state surveillance grantees are required to attend the annual CSTE meeting held in June and the NIOSH Winter Partners Meeting held in December. These meetings not

only promote collaboration between NIOSH and its partners but also provide opportunities for internal collaboration within health departments funded by other parts of CDC. A recent example includes a collaboration between the Nebraska Occupational Safety and Health Surveillance Program and the Childhood Lead Poisoning Prevention Program, funded by CDC's National Center for Environmental Health (NCEH). NIOSH will continue to encourage these types of collaborations.

Sub-recommendation C3:

Explore and implement, as appropriate, alternative approaches to funding ongoing surveillance in the states as applied public health programs rather than research programs.

NIOSH is actively exploring the possibility of funding state surveillance as applied public health programs rather than research programs and published a [Request for Information](#) (84 Fed. Reg. 42920 Aug. 19, 2019) to seek public comment on questions related to this potential approach. NIOSH will consult with other CDC centers to determine how they accomplish this. NIOSH will also continue to inform states when opportunities for funding become available from other CDC centers or programs. In FY2018, NIOSH alerted states to CDC funding opportunities on technical assistance, disaster preparedness/response, and opioids.

Sub-recommendation C4:

Foster increased coordination and communication between its intramural and extramural surveillance programs.

NIOSH plans to continue the series of regular meetings already held with the states.

- CSTE Annual Meeting (June)
- NIOSH Surveillance Partners Meeting (December). All NIOSH-funded state surveillance grantees are required to attend. These meetings provide opportunities for collaboration among state programs and with the NIOSH Surveillance Program.
- Regional State Surveillance Meetings. States help plan these meetings, share project findings, and explore future collaborations in areas of mutual interest or concern, including emerging issues. These include Northeastern (NeON) and Southern (SouthON) States Meetings (both held in April) and Western (WestON) States Meeting (September).
- NIOSH Annual State FACE Meeting (October)
- NIOSH Annual Respiratory Health Program Meeting (June)
- NIOSH Annual Pesticides Meeting (February)
- NIOSH Surveillance Coordination Group (SCG) Monthly Teleconferences with both State and NIOSH representatives in attendance.

Sub-recommendation C5:

Encourage NIOSH-funded Education Research and Training Centers and Agriculture Health and Safety Centers to provide technical and research support to state surveillance programs in their regions as part of their required outreach and education core activity.

Some such collaborations already occur, such as the Iowa Department of Public Health and the Center for Agricultural Safety and Health [efforts to improve farm safety](#). NIOSH will work with funded centers and state surveillance programs to strengthen opportunities for technical and research support. Outreach and continuing education programs, pilot research projects, emerging issues research, academic certificate training programs, and direct connections between state public health departments and academic institutions are all possible mechanisms for achieving this recommendation.

Recommendation D:

BLS should place priority on implementing its plan for a household survey of nonfatal occupational injury and illnesses (HSOII).

NIOSH is not the lead agency for this recommendation.

Recommendation E:

OSHA, in conjunction with BLS, NIOSH, state agencies, and other stakeholders, should develop plans to maximize the effectiveness and utility of OSHA's new electronic reporting initiative for surveillance.

NIOSH is not the lead agency for this recommendation.

Recommendation F: Improve data collections.

NIOSH, with assistance from OSHA, should explore and promote the expanded use of workers' compensation data for occupational injury and illness surveillance and the development of surveillance for consequences of injury and illness outcomes, including return to work and disability.

NIOSH recognizes that workers' compensation (WC) data and systems are important in understanding how to protect workers effectively. After cosponsoring two workshops involving private insurance carriers, insurance associations, self-insured corporations, academic institutions and government agencies ([Use of WC data for occupational injury & illness prevention, 2010](#) and [Use of WC data for OSH, June 2012](#)) on using WC data for occupational safety and health, NIOSH established the [Center for Workers' Compensation Studies](#) in 2013. Its mission is to prevent and reduce work-related injuries and diseases by maximizing the use of WC data and systems in surveillance and research activities. The Center accomplishes its mission through working with private and public insurers and other partners.

NIOSH is actively working toward two goals to accomplish this recommendation:

The first goal is to analyze existing state-level workers' compensation data to define the burden and need for injury intervention across multiple industries. To this end, NIOSH developed an [extramural opportunity](#) that funded five states to expand on the framework of the NIOSH State Surveillance Portfolio, publishing a guide, [Workers' Compensation Insurance: A Primer for Public Health](#), to encourage and guide the use of workers' compensation claims data for public health purposes. NIOSH has also produced multiple products and partnerships that include the following:

- Computer programs to auto-code free text WC claims for causation ([Development and evaluation of a Naïve Bayesian model for coding causation of workers' compensation claims](#) and [Comparison of methods for auto-coding causation of injury narratives](#)). These programs are continuously improved and shared with stakeholders and NIOSH is developing a standalone application (app).
- Publications that demonstrated that state data linkages could be used to examine claim trends and that machine learning techniques could be used to identify industries for ergonomic and safety intervention: [Development of methods for using workers' compensation data for surveillance and prevention of occupational injuries among State-insured private employers in Ohio](#) and [Applying machine learning to workers' compensation data to identify industry-specific ergonomic and safety prevention priorities: Ohio, 2001 to 2011](#)

The second goal is to work with public and private partners to evaluate the effectiveness of prevention approaches and disseminate information on evidence-based interventions. Some examples include the following:

- An [evaluation of the Ohio Safety Intervention Grant program](#) that found the program significantly reduced affected employee claims and costs.
- An interview study with nine insurers to better understand the impact of risk control systems on workplace safety/health and encourage researchers to work more with insurers to evaluate risks/controls and disseminate best safety/health practices. ([Workers' compensation insurer risk control systems: opportunities for public health collaborations](#))

Sub-recommendation F1:

NIOSH should organize an advisory group of workers' compensation data experts to advise both the NIOSH Center for Workers' Compensation Studies and interested states concerning their use of workers' compensation data for surveillance and research.

Due to Federal Advisory Committee Act constraints, NIOSH has not developed a single standing advisory group. However, we regularly consult with experts from different stakeholder groups, including labor, industry, healthcare providers, states, insurance carriers and related groups, academics, and the federal government to discuss workers' compensation analysis

methods and findings. These discussions and dissemination of findings occur via [webinars](#), formal [colloquiums](#), meetings with state grantees and other unfunded states, email lists, and whitepapers on important issues such as denominator calculations.

Sub-recommendation F2:

NIOSH should encourage states to expand the use of workers' compensation information beyond the Council of States and Territorial Epidemiologists (CSTE) occupational health indicators. Specifically, the agency should work through the state surveillance cooperative agreements to develop and enhance use of workers' compensation data for state-based occupational injury and illness surveillance and prevention activities.

NIOSH developed the WC surveillance grant specifically for this purpose. Five states (California, Massachusetts, Ohio, Tennessee, and Michigan) received NIOSH funding. The collaborations are actively creating datasets that merge WC and employment data to allow analyses of WC data across an extensive range of variables including industry, occupation, cause, part of body, and nature of injury. These analyses go far beyond the current CSTE WC indicators. These states have produced several products, some mentioned above, that will be useful to others in expanding capacity to use WC data for prevention. Although there are no current funding plans to continue the specific NIOSH WC grant, it may be possible to integrate several additional key WC metrics into the expanded surveillance grants in the future.

Sub-recommendation F3:

NIOSH and OSHA should collaborate with states to pursue the development of surveillance systems that capture cost of work-related injury and illness, measure work-related disability and return-to-work outcomes, and assess the adequacy of benefits administered through workers' compensation insurance programs.

The NIOSH long term plan is to expand use of WC data in three areas:

- Build capacity in states to examine their data: The initial focus of the WC state grants has been on describing the frequency and rate of claims by cause/industry. This was done in some states as described above but we plan to expand this to more states. We plan to expand analysis to include cost and severity variables.
- Use WC data to understand disability and return to work outcomes: Washington (WA) and Ohio (OH), as state-based insurers, already have the ability to analyze and publish cost and work-related return-to-work (RTW) outcomes. WA has a long history of doing this. NIOSH plans to develop collaborations with other states and to develop collaborations with state funds that are members of the American Association of State Compensation Insurance Funds (AASCIF), which have begun some initial WC claims data pooling. NIOSH will continue to partner with the National Council on Compensation Insurance (NCCI), the Workers Compensation Research Institute (WCRI), and RAND Corporation on these topics. In addition, NIOSH created a blog on

worker recovery and RTW to generate a list of resources for stakeholders and ask key questions regarding gaps ([Worker Recovery and Return to Work](#)) and worked recently with the Department of Labor (DOL) on a [whitepaper](#) focused on improving occupational healthcare delivery to support WC RTW. NIOSH also recently commissioned a [study](#) by RAND Corporation to gain stakeholder input on ways to improve the current WC system to best promote safety/health and worker wellbeing.

- Analyze the cost of work-related injury and disease: This is an ongoing activity. Recently, NIOSH worked with WA and OH to provide some 2018 summary cost data on the construction industry. We plan to continue partnerships with state funds that are members of the AASCIF and plan for state funds to provide collective reports similar to the Liberty Mutual Safety Index in the future. NIOSH has an ongoing partnership with NCCI and is currently conducting analysis on the cost of WC claims across 38 states during 2009–2013 for selected industries and outcomes. NIOSH is also partnering with WCRI to produce [reports analyzing opioid use by industry and occupation](#) in 27 states.

Recommendation G: Prioritize and coordinate OSH surveillance and expand biomedical informatics use and capabilities.

HHS should designate industry and occupation as core demographic variables collected in federal health surveys, as well as in other relevant public health surveillance systems, and foster collaboration between NIOSH and other CDC centers in maximizing the surveillance benefits of including industry and occupation in these surveys and surveillance systems.

NIOSH and other CDC/ CIOs within HHS have made great strides in promoting the inclusion of I/O as core demographic variables.

Sub-recommendation G1:

HHS should reestablish I/O as core demographic variables in all federal health surveys.

Progress on this recommendation is well underway. There are many efforts ongoing by NIOSH and other collaborators. Some examples where I/O have been successfully integrated to some degree include: the BRFSS; the NHIS; the National Violent Death Reporting System, and the National Health and Nutrition Examination Survey (NHANES).

Some examples where NIOSH is currently working to add I/O variables include the following:

- NNDSS: A CDC activity that collects data on cases of 90+ notifiable conditions. Few conditions collect standard work data (I/O) on cases. NIOSH, in collaboration with CDC, created a template to transmit I/O for all notifiable conditions.
- AoU: National Institutes of Health (NIH)-led All of Us (AoU) Research Program is a historic effort to gather data from one million people living in the U.S. to accelerate research and improve health. NIOSH has provided materials for a proposed AoU Occupational History and Health module that will include I/O.

- Cancer registries: While the Cancer Registries Amendment Act of 1992 states that cancer registries will collect industrial or occupational history of individuals with cancer, to the extent it is available from the medical record, only 40% of cancer registry records contain I/O. NIOSH anticipates this will improve substantially as I/O is consistently reported in electronic medical records. Details are covered under response to Recommendation L.

NIOSH will continue to focus its efforts on working with other CDC centers and other federal programs to encourage permanent inclusion of I/O in specific surveys and data collections judged to have the best potential to be informative and useful for surveillance and research. This work will continue in partnership with states and other federal centers or organizations.

Sub-recommendation G2:

CDC surveillance programs, as they proceed with their state partners to streamline and harmonize data across systems, should work with NIOSH to identify appropriate processes for collecting and coding occupational and industry data.

Over the past 10–12 years, NIOSH has succeeded in achieving the following in accordance with this recommendation. Here are some tools that make it easier for partners to incorporate the information:

- NIOCCS has provided the opportunity to code text fields that was not available in the past. Since it was launched in 2012, NIOCCS has coded nearly 40 million I/O records submitted by various types of users and from different data sources.
- A new project is exploring the use of NIOCCS for EpiInfo, a data collection and analysis software program created and maintained by CDC. This project will encourage collection and use of I/O data in field surveys and surveillance systems by enhancing NIOCCS to be a real-time, record-by-record coding tool for free-text I/O data.

Newer efforts for partnerships to streamline and harmonize data collection regarding I/O include these:

- Electronic Case Reporting: The [Digital Bridge](#) partnership is leading efforts to modernize public health case reporting to state and local agencies through development of electronic case reporting. NIOSH, with partners at CSELS, CSTE, and state programs, has begun to develop the codes needed for work-related conditions that may be reportable. Silicosis is the first condition to be completed. NIOSH and partners are currently developing code information for work-related asthma. Work on additional conditions will follow.
- NNDSS NMI: NIOSH worked with CSELS, through the NMI, to create a template that would permit jurisdictions to transmit standard I/O data as a part of data

collected for notifiable conditions. NIOSH and NCEH are developing Message Mapping Guides for adult and childhood lead levels.

- Vital Records: The standard U.S. death certificate includes usual I/O of adult decedents. For forty years, NIOSH has collected and coded I/O from death records from selected states to assess trends in mortality. NIOCCS has provided the opportunity to code usual I/O of all adult deaths for full harmonization of I/O codes on death records. In 2020, NIOSH anticipates that most states with electronic death record systems will participate in a program to code, using NIOCCS, industry and occupation on all death records.

NIOSH will continue to improve the speed and accuracy of NIOCCS coding and throughput using available information technologies. Continual upgrade and maintenance of the NIOCCS system is and will continue to be a high priority. The adoption of machine learning techniques should enhance coding speed and accuracy. We will continue to develop message mapping guides and partner in the Digital Bridge initiative.

In the long term, NIOSH will investigate how to collect I/O responses via questionnaire that provide the most informative data for the situation and which is usable for public health or population health.

Sub-recommendation G3:

NIOSH, with assistance from CDC, should explore and prioritize public health surveys that can be used to enhance occupational health surveillance objectives by collecting relevant occupational information.

The NIOSH Surveillance Program has found cost efficient ways to utilize survey data collected by other organizations that contain information on work, e.g., I/O and other aspects of work, work-related diseases, injuries, and/or exposures. The host organizations pay the majority of the costs of developing, testing and launching the surveys, in addition to developing sampling frames and collecting the data. If questions on work are missing or do not collect the most important data, NIOSH sponsors questions on respondents' occupation and industry or on specific conditions or issues related to work-related conditions, exposures or diseases.

NIOSH sponsored supplemental work-related questions in the 2010 and 2015 [NHIS surveys](#) and plans to sponsor another supplement in 2021. In addition, NIOSH plans to continue sponsoring an optional module in BRFSS to collect I/O. Up to 30 states have used this module during 2013–2019. The Current Population Survey is used to estimate monthly [absenteeism](#) relating to seasonal flu events; and the occupational supplement to the National Electronic Injury Surveillance System ([NEISS-Work](#)) is used for injury tracking.

NIOSH will continue to expand its use of data from all types of surveys and national and state data collections not generally designed for occupational health use, as appropriate. NIOSH will collaborate with other CDC centers to examine public health surveys functioning as surveillance

data collection tools to determine appropriateness and cost of including I/O. It is possible that a new NIOSH-wide system for storing and analyzing data scheduled for implementation in the next few years will help OSH surveillance efforts by providing a single platform that allows analysis across systems and data mining not easily conducted in the current CDC data environment.

In the long term, NIOSH will continue to identify additional data sets from which information on work-related diseases and injuries might be extracted. This may include insurance data, and other sources of health or injury information. Some of these data may be available through CDC's data platform.

Sub-recommendation G4:

To promote proper analysis of surveillance data NIOSH should develop methods and training materials on approaches to basic as well as new and creative use of occupation and industry data and on the selection and use of appropriate labor force denominators (long term recommendation).

NIOSH and partners will expand training activities for the public health workforce on methods, including: how to properly collect I/O, standard coding procedures, proper analysis, and interpretation. Training channels may include YouTube and other online training platforms. ERCs and NIOSH training centers could be one type of venue. Collaborations between NIOSH and other CDC centers may provide consultation to OSH data users on new and innovative methods. Multiple systems can be included such as BRFSS, Cancer Registries, death certificates, and NNDSS.

NIOSH is developing a whitepaper that describes the issues and recommendations in denominator sources for calculation of rates.

NIOSH could collaborate with appropriate CDC centers and agencies to hold a workshop to continue discussions on current issues related to use of denominators for calculation of rates for surveillance efforts. Other activities that will advance the utilization of NIOSH data by internal and external partners could include development and enhancement of systems capable of being queried using real-time analytics (see Recommendation O).

Recommendation H: Improve data collections.

NIOSH, in consultation with OSHA, should place priority on developing a comprehensive approach for exposure surveillance.

NIOSH's National Occupational Exposure Survey collected data during 1981–1983 on occupational exposures to chemical, physical, and biological agents in over 500 industries that employ more than one million workers. Since 1983, the United States has lacked a survey focusing on workplace exposures. In its place, NIOSH utilizes existing surveys and data systems

created by others that contain some exposure information to evaluate and track exposure trends. Examples of these data sources include:

- OSHA Information System (OIS) and its predecessor, the Integrated Management Information System (IMIS), are an OSHA administrative system to record information from compliance inspections and consultation surveys conducted since May 1979.
- The [Occupational Information Network](#) comprised of several hundred standardized measures of job characteristics across occupations, as well as occupation-specific descriptors (tools and technology), providing extensive information on the physical requirements of work, job hazards (e.g., noise), and work organization (e.g., decision making authority).
- The [Occupational Requirements Survey](#) (ORS), a survey conducted by the BLS which gathers job-related information regarding physical demands, environmental conditions, mental and cognitive demands, and vocational preparation requirements.
- [Mine Safety and Health Administration \(MSHA\) data files](#) on mining accidents, injuries, fatalities, employment, and production collected by MSHA contain some exposure information.
- MSHA Metal/Nonmetal Mine Data industrial hygiene samples collected by MSHA inspectors in noncoal surface and underground mines and mills since 1974: [Sources of Data](#).
- OSHA's [Chemical Exposure Health Data \(CEHD\)](#) is a publicly available exposure dataset that consists of exposure records submitted for analytical analysis at OSHA's Salt Lake Technical Center and contains additional useful fields such as sampling time and analytical method that are useful in interpreting results.
- The [Defense Occupational and Environmental Health Readiness System Industrial Hygiene \(DOERHS-IH\)](#) tracks biological, chemical, and physical health hazards to service members worldwide.
- The [Defense Occupational and Environmental Health Readiness System Hearing Conservation \(DOERHS-HC\)](#) collects maintains, compares, and reports hearing readiness, deployment, and hearing conservation program data. NIOSH has entered into a Data Use Agreement to obtain audiograms from DOEHRS-HC and exposure data from The Defense Occupational and Environmental Health Readiness System Industrial Hygiene (DOEHRHS-IH). This agreement will increase understanding and could improve the possibility of a future joint venture.
- Workers' Compensation Records: Workers' compensation insurers are some of the largest collectors of occupational exposure data. If analyzed, these data may help identify priority hazards and trends over time because the data include worker exposure

information. The data could also be used to develop strategies for controlling exposures that would improve worker health. Workers' compensation exposure data could be more usable if there were improvements to data storage, standardization of data collection, and collaboration between researchers and the insurers.

- [Beyond determining compliance: how can workers' compensation insurers' exposure data be improved and used?](#)
- [Occupational exposure monitoring data collection, storage, and use among state-based and private workers' compensation insurers](#)
- [Standardizing industrial hygiene data collection forms used by workers' compensation insurers](#)
- [Workers' compensation insurer risk control systems: opportunities for public health collaborations](#)

Sub-recommendation H1:

NIOSH should fully exploit the existing OSHA exposure databases by cleaning and integrating all available data sources to make them useful for surveillance purposes, taking proper account of the database limitations.

NIOSH can continue to utilize the existing exposure databases described above for surveillance purposes, taking proper account of the database limitations. Use of the NIOCCS to code occupation title free-text fields into Census Occupation Codes and other tools makes these data sources more accessible.

Sub-recommendation H2:

NIOSH, in collaboration with OSHA and other agencies, as appropriate, should construct an integrated exposure database to include the multiple sources of exposure measurement data already available, specifically MSHA's Standard Information System (MSIS), Department of Energy (DoE) and Nuclear Regulatory Commission (NRC) personal exposure data, and relevant data from others conducting research with federal funds.

An integrated exposure database consisting of data from multiple available datasets can be a useful surveillance tool in identifying hazards and at risk workers throughout the U.S. NIOSH will discuss feasibility with OSHA and other partners. Potential datasets with personal exposure measurements include OSHA IMIS, OIS, and CEHD; MSHA Standardized Information System (MSIS); DoE/NRC Radiation Exposure Information and Reporting System (REIRS) and Radiation Exposure Monitoring System, as well as others such as DoD's DOERHS-IH, and NIOSH's Health Hazard Evaluations. Separately, these datasets do not provide a full representation of all workers or exposures they encounter as the data have been collected as a result of agency missions. However, by combining these datasets, a more robust database can be created that moves closer to truly being a representation of the nation's workforce.

Collaborations among these federal agencies is needed to 1) identify standardized variables common among the datasets and useful for surveillance purposes, 2) identify data cleaning and merging steps for each dataset, 3) create a singular data dictionary that includes the unique attributes and options of all the data fields, 4) identify the preferred frequency and method to upload data, and 5) determine the rules governing the availability and use of such data.

Sub-recommendation H3:

NIOSH should link the integrated exposure database with the comprehensive survey data obtained in the recommended expanded HSOII and new data from any characterization of exposures from targeted industry- specific assessments.

The Bureau of Labor Statistics conducted a Household Survey of nonfatal Occupational Injuries and Illnesses (HSOII) pilot as a way to supplement information on workplace injuries and illness. BLS is evaluating the results of this pilot and considering options moving forward. As this effort progresses, NIOSH will determine if integration with exposure databases will be possible.

Sub-recommendation H4:

NIOSH and OSHA should explore the feasibility of receiving employer-mandated exposure sample results after considering the reliability and quality of these measurements. The agencies should work with stakeholders to develop software and other tools and to facilitate establishment-level analysis of exposure data along with benchmarking.

Although this recommendation focuses on OSHA and employer-mandated exposure results, NIOSH believes it is more feasible to collaborate with workers' compensation insurers to utilize exposure databases to achieve this goal. Next steps to improve the use of these occupational exposure data may include: 1) Encouraging insurance companies to share or pool their occupational exposure data for use outside of their organization. Pooling data within a company, and among several companies, would benefit exposure surveillance and may help insurers provide better service to their customers. 2) Expanding researcher and insurance company collaboration to advance occupational exposure data accessibility and application. There is a demand for efficient and affordable electronic data management systems tailored to insurance companies' data collection needs. 3) Identifying which substances or agents are most commonly monitored by insurers (and collect more detail on insurers' occupational exposure data sampling practices).

Recommendation I: Strengthen data analysis and information dissemination for prevention.

NIOSH should coordinate with OSHA, BLS, and other relevant agencies to measure and report, on a regular basis, the economic and health burdens of occupational injury and disease at the national level.

- **Sub-recommendation I1:** *Focusing attention on the significant burden that already exists.*
- **Sub-recommendation I2:** *Measuring progress over time in reducing those burdens and improving worker safety and health.*
- **Sub-recommendation I3:** *Improving the allocation of existing resources to improve health outcomes.*
- **Sub-recommendation I4:** *Establishing priorities.*

These sub-recommendations are addressed together.

NIOSH uses the “Burden, Need, and Impact” approach to provide a strategic, structured, consistent, and transparent method to identify the highest occupational safety and health priorities and determine Institute research decisions that will have the greatest impact, in terms of reducing burden and improving well-being. (Felkner, 2019) The NIOSH Surveillance and Economic Programs are largely responsible for developing and providing data on burden at the national level using several sources. This includes general health surveillance metrics such as the magnitude of the problem as measured by counts or rates of a condition, exposure metrics, and trends by industry as well as related economic metrics.

NIOSH has developed a framework (see Figure 1) for assembling and reporting standardized information on the work-related burden of injury and disease. Box 1 contains burden information on conditions that have been well-established as work-related. Box 2 contains information on emerging issues or conditions that are less well-established. These conditions may have work and nonwork related causes. Information on the conditions in Box 2 require further investigation or research into the associations among causes and conditions. Box 3 includes future exploratory metrics of burden and well-being using new data sources as they become available.

The initial effort to measure and report economic and health burden in a systematic approach has focused on established work-related conditions (Figure, Box 1). A paper with estimates of the attributable fraction of well-established occupational diseases and updated estimates of injuries at the national level for year 2012 has been [published](#). This is the first time NIOSH has estimated incidence-based attributable fractions of selected diseases at the national level. The next step will be to use the health burden from this paper to develop and report estimates of

economic burden. NIOSH plans to develop national estimates of health and economic burden at regular time intervals.

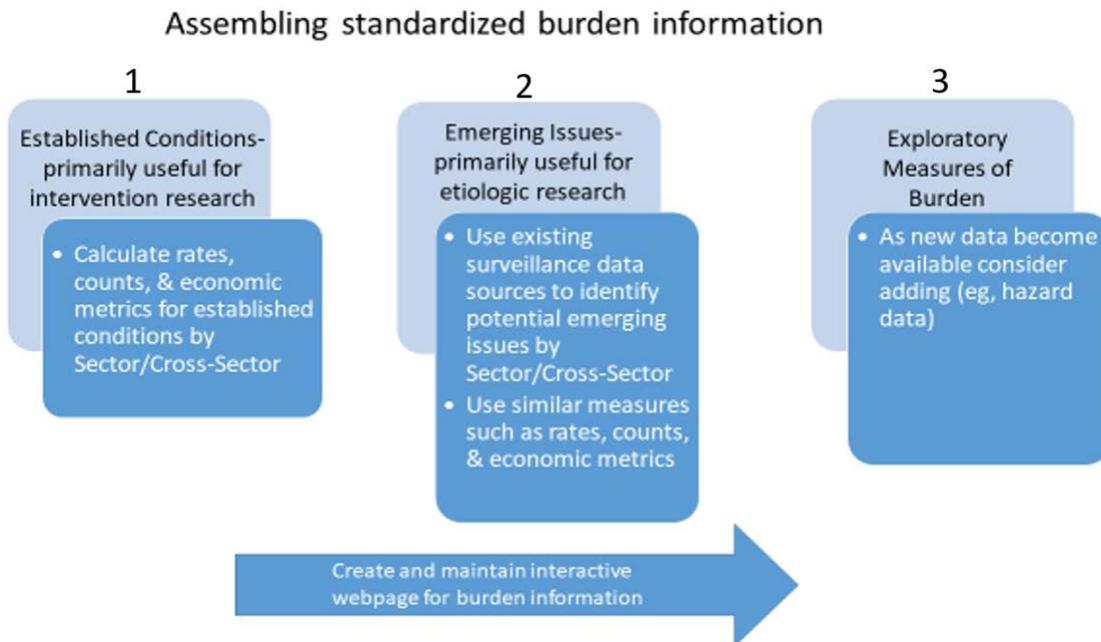


Figure 1 Assembling Standardized Burden Framework

NIOSH plans to establish an Institute-wide workgroup charged with long term implementation of Recommendation I that includes surveillance, economic, and information technology (IT) subject matter experts. This workgroup would periodically update the burden estimates in Box 1 of the figure above and develop a method for reporting health and economic estimates for conditions that fall into Box 2. The burden estimates will be incorporated into the communication plan described in Recommendation O.

The workgroup would also reach out to the DOL, as well as other federal partners and states, to obtain information on their data collection and reporting mechanisms in order to coordinate and improve the reporting of occupational injury, disease, and economic information in a more consistent and structured approach as described under Recommendation O.

A long term implementation objective of the Institute-wide workgroup will be assessing other data systems to expand the ability to better define the burden of occupational injuries and diseases (See Figure 1, Box 3). The types of information obtained from these data sources would be especially useful in the development of additional economic metrics, including assessments of quality of life and well-being, and would provide information for Box 3 in the framework. This enhanced activity would include:

- Monitoring progress on exposure surveillance (as described under Recommendation H) and, if feasible, incorporating these data into the reporting process, including the economic consequences of these exposures;
- Continue evaluating nontraditional data sources to assess burden in a broader context (e.g., long term disability associated with a health outcome, longitudinal data that assesses work impacts on well-being).

Included would be ongoing work to develop the necessary methods and approaches for incorporating economics into the reporting process for new data as added, and application of broader metrics, such as quality of life, to define burden and well-being. Such measures would provide a more comprehensive and coordinated Institute approach for assessing and reporting burden.

Recommendation J: Prioritize and coordinate OSH surveillance & Expand biomedical informatics use and capabilities.

NIOSH should build and maintain a robust internal capacity in biomedical informatics applied to OSH surveillance.

The NA committee observed that OSH surveillance has not taken advantage of existing and emerging information technologies because very few people trained in biomedical informatics are aware of OSH, and few OSH surveillance stewards are trained in biomedical informatics. In 2005, the Board of the American Medical Informatics Association (AMIA) defined [biomedical informatics](#) as “the interdisciplinary field that studies and pursues the effective uses of biomedical informatics data, information, and knowledge for scientific inquiry, problem solving and decision making, motivated by efforts to improve human health.”

- **Sub-recommendation J1:** *Assess the need within the agency for expertise in biomedical informatics in the context of current and future demand—recognizing that it will be important to train biomedical informatics talent in OSH surveillance—and then work to retain talented individuals who develop knowledge at the intersection of biomedical informatics and OSH.*
- **Sub-recommendation J2:** *Create an organizational strategy for deploying and making optimal use of expertise in biomedical informatics to support the planning and conduct of OSH surveillance.*
- **Sub-recommendation J3:** *Develop a plan for hiring, including consideration of steps such as reaching out to academic programs, advertising in different venues, and offering internships.*
- **Sub-recommendation J4:** *Develop a plan for retention, including opportunities for continuing education.*

NIOSH will place a priority on these four sub-recommendations related to bioinformatics, both in the short term and long term.

NIOSH will work across the Institute with partners in workforce development and surveillance to leverage biomedical informatics personnel assessment expertise. NIOSH may also consult with experts on biomedical informatics personnel in the CDC's Informatics Workforce Development Team within the Division of Scientific Education and Professional Development, the Division of Health Informatics and Surveillance, the Informatics Innovation Unit (IIU) within the Division of Public Health Information Dissemination, the Public Health Informatics Fellowship Program, non-CDC agencies (e.g., NIH, BLS), and nonfederal entities (e.g., AMIA, American Health Information Management Association) to identify methods for helping NIOSH address identified biomedical informatics personnel gaps.

The NIOSH Associate Director for Information Technology will recruit the informatics engineering expertise required. The NIOSH Surveillance Program will identify appropriate subject matter experts and communications experts. These two groups will establish a team to integrate and coordinate current systems and formulate a unified approach. Similar capacity building in informatics should be encouraged within the extramural public health community.

NIOSH will improve upon and expand the strategies for recruitment, retention, and training and continue to update the inventory of onboard informatics knowledge, skills, and abilities and adjust its plan according to current needs and gaps.

Recommendation K: Expand biomedical informatics use and capabilities.

NIOSH should work with the National Library of Medicine to incorporate core OSH surveillance terminologies, including those for industry and occupation, into the Unified Medical Language System (UMLS).

Controlled terminologies will ensure OSH concepts are recorded consistently by different people over time within- and between-surveillance systems by enumerating the accepted and standard ways for concepts to be encoded. Existing OSH controlled terminology systems (e.g., Occupational Injury and Illness Classification System (OIICS), North American Industry Classification System (NAICS), Standard Occupational Classification (SOC), International Classification of Diseases (ICD), and Workers Compensation Insurance Organizations System) do not cover all OSH terminologies and are not mapped to each other.

- **Sub-recommendation K1:** *Establish an inventory of relevant OSH terminologies.*
- **Sub-recommendation K2:** *Develop use cases that benefit from the existence of mappings across OSH terminologies.*
- **Sub-recommendation K3:** *Prioritize terminologies in terms of the value that accrues from incorporating them into the UMLS.*

Implementation of this recommendation is part of a long term strategy. NIOSH will create a comprehensive inventory of relevant OSH terminologies, solicit existing use cases or user stories from across NIOSH that contextualize OSH concepts, and produce a list of the top 50 OSH terms using keywords listed in NIOSHTIC2 publications and/or other appropriately deemed sources.

NIOSH may also seek expertise in terminology development and deployment to ensure that terminology is defined in a compatible manner with UMLS. It may be possible to create a use case template that is compliant with the UMLS meta-thesaurus structure (i.e., concepts, attributes, etc.) to be used for existing and new use cases in order to promote harmonization of OSH terminologies across surveillance projects and systems. Additional steps may include developing a searchable catalog that links these defined use cases to their associated OSH terminologies.

Sub-recommendation K4:

Incorporate highest-priority OSH terminologies into the UMLS (long term recommendation).

In the future, NIOSH may collaborate with the National Library of Medicine to assist with incorporating the core OSH surveillance terminologies into UMLS.

Recommendation L: Expand biomedical informatics use and capabilities.

NIOSH should lead efforts to establish data standards and software tools for coding and using occupational data in electronic health records.

Clinical records have had limited utility in occupational health surveillance in the United States. Information about the work of patients, if present at all, is captured as text in the social history or in written narratives. The emergence of EHRs as the principal repository of medical information creates the opportunity to systematically capture information about work and to record it in a structured fashion, enabling utility for clinical care and occupational health surveillance. The Office of the National Coordinator for Health Information Technology (ONC) provides the framework within which the healthcare sector develops and implements rules pertaining to the capture and exchange of health information. This process provides NIOSH an opportunity to influence how occupational information is recorded and structured to support clinical and public health goals.

Sub-recommendation L1:

Develop a consensus within the OSH surveillance community regarding the preferred terminologies and tools for extracting data on industry and occupation from the EHR.

This activity is well underway. In 2011, NIOSH sought input from the Institute of Medicine (IOM) on the rationale and feasibility of incorporating occupational information into EHRs. In a letter report issued that year, the committee recommended adopting NAICS and SOC coding standards for use in EHRs ([Incorporating Occupational Information in Electronic Health](#)

[Records](#)). In 2012, guided by this report and by input from ONC and the Health IT Policy Committee (one of its Advisory Committees), NIOSH began exploring how to collect standardized industry and occupation in EHRs. NIOSH has iteratively explored user interface design approaches that help guide a person to select terms that can be categorized according to public health needs.

This approach will also address recommendations expressed by a National Academies of Medicine, Institute of Medicine Committee on Recommended Social and Behavioral Domains and Measures for EHRs in their 2014 report, [Capturing Social and Behavioral Domains and Measures in Electronic Health Records: Phase 2](#) (The National Academies Press, Washington, D.C.: November 13, 2014). The Committee was tasked by NIH, Centers for Medicare and Medicaid Services (CMS), and others to “identify domains and measures that capture the social determinants of health to inform the development of recommendations for Stage 3 meaningful use of electronic health records (EHRs).” The final report states, “[an] example of an important domain that is not yet feasible for inclusion in EHRs is occupation...,” and that “Despite its importance, the currently available measures of occupation are lengthy and complicated to code. As a result, occupation was not included in the recommended panel. Currently this coding for occupation is too time intensive to be practical for use in an EHR, but if this hurdle can be overcome, it could be added at a later time.” NIOSH efforts are intended to overcome this hurdle.

To facilitate sharing of occupational data (along with clinical data) between EHRs and public health information management systems, NIOSH has put considerable effort into defining “occupational data for health” (ODH), describing system features needed for its collection and use, and incorporating it into interoperability data formatting standards. NIOSH is finalizing a publication describing an entity relationship information model of ODH.

NIOSH worked with Health Level Seven (HL7) to finalize a “functional profile” that describes the features for EHR software to be able to collect and use ODH. The intention is to make these new and modified functions and conformance criteria available now so they can be incorporated into a future release of the [Electronic Health Record – System Functional Model](#).

NIOSH also worked with multiple HL7 workgroups to incorporate templates into the three “families” of data formatting standards for Health IT interoperability. By preparing these ODH templates, NIOSH is providing a format for any interoperability need, including sharing data with public health.

NIOSH will continue working to support the collection of ODH in EHRs that will be useful for patient care and population health activities as well as meeting public health needs. NIOSH also plans to continue work in HL7 to incorporate ODH in foundational standards as well as standards for specific uses, such as case reporting.

Sub-recommendation L2:

Engage with ONC to communicate this consensus to other stakeholders and to establish a broader consensus among all stakeholders regarding an acceptable strategy.

In 2010 and 2012, NIOSH provided testimony to workgroups of the ONC Health IT Policy Committee, describing the value of including work information in EHRs. NIOSH continued to inform ONC through comments in response to proposed regulatory actions and other avenues. The 2015 Edition Health Information Technology (Health IT) Certification Criteria, 2015 Edition Base Electronic Health Record (EHR) Definition, and ONC Health IT Certification Program Modifications; Final Rule published in the Federal Register October 16, 2015 [80 FR 62601], stated, “we continue to believe in the value of I/O information to improve patient health outcomes...” and “Our long term goal is for health care providers to use I/O information to assess symptoms in the context of work activities and environments, inform patients of risks, obtain information to assist in return-to-work determinations and evaluate the health and information needs of groups of patients.”

NIOSH provides input on the listing for industry and occupation in the ONC’s [Interoperability Standards Advisory \(ISA\)](#). The ISA is an ONC-managed catalog of “best available” standards and vocabulary for Health IT, based on community consensus that is continuously updated online and published annually as a pdf. NIOSH recently submitted information to ONC updating available vocabularies for industry and occupation.

Sub-recommendation L3:

Support ONC in the process of establishing a rule to require the capture of industry and occupation in the EHR.

In order to consider including capture and use of industry and occupation data elements in regulatory requirements, ONC needs to have standards and testing procedures for ensuring that EHRs meet the objectives. NIOSH has been working steadily on the former (under Sub-recommendation L1, above), but has not yet started to develop quality measures to be used to incentivize collection and use of ODH, including industry and occupation data elements.

NIOSH worked with partners to develop resources for clinical decision support to encourage care providers to consider work in patient care. The resources address three topics: managing diabetes in challenging work environments, writing a return-to-work letter for low back pain not caused by work, and recognizing and addressing work-related asthma. These [resources](#) and accompanying [compendium](#) of journal articles have been posted by the American College of Occupational and Environmental Medicine (ACOEM).

The diabetes and work knowledge resource has been posted on the Agency for Healthcare Research and Quality (AHRQ) [clinical decision support repository](#), and the use of the information in this resource was demonstrated in the Interoperability Showcase at the Health Information Management and Systems Society (HIMSS) annual meeting in 2018. At least one

company is applying the information in the knowledge resource in development of a product to help monitor and manage glucose levels.

ONC and CMS have collaborated to establish the use of EHRs to achieve the “triple aim” of better health, better care, and lower costs. ONC has supported and promoted the use of Health IT while CMS has incentivized capture and “meaningful use” of the data. To address this recommendation, it will be necessary for NIOSH to both determine how best to certify EHRs for suitable capture and use of ODH, and to engage CMS in incentivizing collecting and using of the data. The recent proposal by ONC to develop the U.S. Core Data for Interoperability (USCDI) provides an opportunity for NIOSH to work with the ONC to ensure collection of occupational information. NIOSH is exploring what is needed to establish quality measure(s) that could be used by CMS to incentivize collection and use of ODH, including industry and occupation data elements. NIOSH also started to work on clinical decision support with a goal of incorporating this as another research-to-practice tool.

Sub-recommendation L4:

Work with the occupational medicine and general medicine community to develop models and tools for using occupational data in electronic health records for clinical care and for serving the prevention needs of the clinical population (long term recommendation).

All the activities described above under Sub-recommendation L1–L3 are directed toward accomplishing Sub-recommendation L4.

Recommendation M: Expand biomedical informatics use and capabilities.

NIOSH and BLS, working with other relevant agencies, academic centers, and other stakeholders, should coordinate and consolidate, where possible, efforts to develop and evaluate state-of-the-art computational and analytical tools for processing free text data found in OSH surveillance records of all types.

Currently, there are three auto-coding efforts being conducted in the Surveillance Program at NIOSH:

- 1) WC cause of injury narratives: In partnership with the Ohio Bureau of Workers’ Compensation (OHBWC), NIOSH maintains a database of workplace injuries filed with the bureau. This database contains a free-text field, usually filled out by the injured worker, describing the circumstances leading to the injury (for example, while lifting heavy box, felt pop in back). NIOSH collaborated with researchers from BLS, Purdue University, and Liberty Mutual Insurance to develop and implement machine learning models, found in the open-source software Python, to auto-code these free-text narratives to the standardized event/exposure OIICS codes. These models were fit on a manually coded training set of ~10k narratives using regularized logistic regression from the Scikit-learn Python library. [The model has been shown to be very accurate in](#)

[predicting the cause of injury](#) (with accuracy scores ranging from 70%–90% depending on the level of detail of the causation category).

- 2) BLS cause of injury narratives: NIOSH is also using machine learning to classify injury narratives to the BLS OIICS. The project is using about 230,000 human-coded cases to train a machine. In 2019, a NIOSH-led team of multiple federal agencies began to crowdsource intramural artificial intelligence programmers to improve the natural language processing algorithm. The intramural competition improved the algorithm from 83% to 88% by using deep learning neural networks to train the machine. Through an Interagency Agreement, NIOSH will be hosting a public competition through NASA's Center of Excellence for Collaborative Innovation—a collaboration with the Laboratory for Innovation Science at Harvard. All the open-source algorithms and training data will be published in 2021 for public use.
- 3) I/O narratives: NIOCCS is a web-based software tool designed to translate I/O text to standardized codes. NIOSH met with the Census Bureau to understand the Census-developed I/O coding system used to manually code Census data. The Census Bureau provided NIOSH one million coded records for the NIOCCS developers to use as training data in the development of the NIOCCS coding algorithms. Beta testing was performed by system stakeholders and the first version of NIOCCS was launched publicly in December 2012. NIOCCS also has the capacity to code industry to NAICS and occupation to SOC.

Sub-recommendation M1:

Conduct an inventory of activities and key stakeholders.

In 2016, the NIOCCS team hired a contractor to perform an inventory of activities in the area of I/O auto-coding. This resulted in a summary of available products that include the SOCCer system (developed by researchers within the NIH) and SOCEye (developed by researchers from Drexel University). NIOSH is currently working to update this inventory list with more current information and to expand the inventory list to other free-text processing activities.

Sub-recommendation M2:

Support knowledge exchange activities (symposia, competitions).

NIOSH has hosted two webinars with researchers from BLS, Purdue University, and Liberty Mutual Insurance presenting techniques and tools for auto-coding free-text injury narratives. The focus of these webinars was on methods and hurdles in categorizing narratives describing causation of injuries. These webinars helped facilitate collaboration and led to the machine learning methods currently being used by NIOSH.

NIOSH will host these types of webinars for researchers working on similar topics in the future. In particular, researchers from BLS have offered to share teaching materials that demonstrate the more advanced neural network models that they have begun incorporating to auto-code

their SOII data. These models can be implemented using the open source libraries PyTorch (offered by Facebook) and/or TensorFlow (offered by Google).

In FY 2017, NIOSH established an agreement with researchers from Carnegie Mellon to collaborate on ways to improve auto-coding methods of both I/O and workers' compensation data. This partnership has helped NIOSH stay current on auto-coding methods.

As mentioned in Sub-recommendation M1, NIOSH will be hosting a public competition through NASA's Center of Excellence for Collaborative Innovation—a collaboration with the Laboratory for Innovation Science at Harvard—to develop the best natural language processing algorithm for injury classification.

In the future, NIOSH will look to participate in conferences and symposia on machine learning. This may elicit future collaboration between additional partners and researchers.

Sub-recommendation M3:

Develop open data sets that can be used to consistently evaluate methods for extracting OSH data from free text (long term recommendation).

As a first step, NIOSH, working with other partners and consultants, will identify currently available open data sources. For example, the Census Bureau has provided a sample of 10,000 free-text responses to the questions “What kind of business or industry was this?” and “What kind of work was this person doing?” from their American Community survey questionnaire. This can be found at [Industry and Occupation Indexes](#).

By 2021, the NIOSH-led team with multiple federal partners mentioned in Sub-recommendation M1 will publish a dataset containing about 230,000 cases with human-coded injury narratives found on hospital records within the NEISS database. The data will be the first of its kind—making public a large set of cases where unstructured injury narratives were used to classify incidents to the BLS OIICS. The data will be accompanied with open-source machine learning natural language processing deep learning neural network algorithms to show public users how they can use this resource to machine-code their data.

NIOSH will continue to look for opportunities to de-identify current data-sources to make them publicly available for researchers to benchmark various approaches.

Recommendation N: Strengthen data analysis and information dissemination for prevention.

To identify emerging and serious OSH injuries, illnesses, and exposures in a timely fashion, NIOSH (in coordination with OSHA, BLS, and the states) should develop and implement a plan for routine, coordinated, rapid analysis of case-level OSH data collected by different surveillance systems, followed by the timely sharing of the findings.

NIOSH currently maintains a variety of surveillance activities that are used to monitor changes in occupational injury, illness, and disease patterns. In addition, NIOSH works with partners

within CDC and other federal agencies to obtain occupational injury, illness, disease, and hazard/exposure data. Key data providers include CDC's National Center for Health Statistics, BLS, OSHA, MSHA, and Consumer Products Safety Commission. In addition, NIOSH maintains an ongoing extramural program to support occupational health surveillance in 26 states. These internal and external surveillance activities include both population-based and sentinel case-based approaches.

NIOSH recognizes that more timely data sharing and improved communication across agencies increase the state and federal governments' ability to identify emerging injuries, diseases, and exposures. A recent example of a successful identification of an emerging hazard illustrates the importance of ongoing communication between states, NIOSH, OSHA, and BLS—the identification of worker fatalities related to tank gauging hazards on oil and gas sites. An initial fatality case was identified by a state occupational health manager who notified NIOSH of this hazard. This led to a coordinated cross-agency/industry response, resulting in the widespread awareness of the issue, the development of new industry standards, and an apparent reduction in the number of deaths from tank gauging activities ([Sudden Deaths Among Oil and Gas Extraction Workers Resulting from Oxygen Deficiency and Inhalation of Hydrocarbon Gases and Vapors—United States, January 2010–March 2015](#)).

NIOSH currently maintains relationships with a variety of federal and state partners to conduct occupational health surveillance. Relationships with federal partners include formal interagency agreements and interagency memorandums of understanding. Formal agreements with states are currently maintained through contracts and cooperative agreements. NIOSH's use of these existing relationships with federal and state partners to more effectively analyze, identify, and respond to significant, or emerging occupational health issues has been occurring on a regular basis. Approaches to expand their existing relationships are outlined below.

To improve data sharing and collaboration, NIOSH, will work with OSHA, and BLS to pursue various available mechanisms to facilitate cross-agency collaboration. There are a number of possibilities for obtaining information on emerging issues that are not within existing population-based and case-based systems. Notification of these events is the first challenge in addressing this recommendation. NIOSH will consider different approaches to creating a conduit of information of emerging issues. One approach is to establish an open forum that meets on an ongoing basis to bring state and federal agencies together for the explicit purpose of discussing novel cases and emerging hazards. This type of forum would ensure that these essential conversations occur in a timely manner. Another approach could be the use of CDC's Epidemic Information Exchange (Epi-X) for notification of cases.

Sub-recommendation N1:

Develop analytical objectives, identifying the outcomes that would benefit from routine, rapid analysis and continuous monitoring across OSH surveillance systems.

Following the development of approaches to notify the occupational health community in a timely manner (see Recommendation N), analytics can be used to monitor these cases. The forum described above could assist in defining the analytical objectives of a routine, rapid analysis. NIOSH may also develop a defined standard for the information to be shared for key outcomes that would be reported in a system of systems that can be mined to detect aberrations (i.e., emerging hazards). This information would likely be aggregated data that would include time and geographic and personal attributes that could be incorporated into the website for communication of surveillance findings. This communication plan is described under Recommendation O.

Sub-recommendation N2:

Review technical and legal strategies for conducting analysis, including novel analytical methods and strategies for distributed analysis and ongoing analysis as the data evolve over time.

Many of the real-time case-level OSH surveillance systems are managed outside of NIOSH by other federal agencies, state governments, and/or private health care providers. To obtain information from these systems in a routine manner for identifying emerging hazards, technical and legal concerns must be addressed.

NIOSH will review various legal and technical strategies for these analyses. NIOSH is currently implementing a new robust and secure data system that has the capacity to ensure more secure data sharing. CDC is also beta testing block chain technology that ensures encryption across a distributed environment, making it even more secure. This technology also allows for data sharing across agencies that can be set to conform to data use agreements (i.e., sharing of only certain variables) between agencies. Distributed analysis may also provide some opportunities for sharing and analysis of data. The implementation of this or a similar technology will be evaluated and shared with BLS, OSHA, and states for feedback and potential use for rapid analysis.

These additional strategies could also be considered:

- Federal agencies work directly and issue joint extramural funding opportunities to address mutually agreed upon objectives, including rapid case identification and application of new analytic strategies to surveillance data. Funding opportunities with flexible cycles could be made available.
- The NIOSH-funded Ag Centers, Total Worker Health Centers, and ERCs could be funded to provide training opportunities for state occupational health personnel and others to conduct analyses that can identify emerging occupational injuries and diseases.

Such centers could provide technical support to states by embedding trainees in state health and labor departments to assist with surveillance activities. This approach is described under Recommendation P.

Sub-recommendation N3:

Implement routine processes for rapid data analysis, including protocols to guide the interpretation of aberrations in the surveillance data.

NIOSH will establish routine processes for conducting rapid analysis using the analytical objectives, outcomes, and OSH surveillance systems identified. The use of small area estimation and detection aberration will be utilized where possible. Protocols for what actions need to be taken upon identification of aberrations will be outlined by NIOSH with input from BLS, OSHA, and states. Subject matter experts for key exposures and injury and disease outcomes will be identified across state and federal agencies in preparation for the identification of emerging hazards so prompt notification and action can be taken to respond.

Recommendation O: Strengthen data analysis and information dissemination for prevention.

To promote and facilitate the use of surveillance information for prevention, and to present more comprehensive information on the extent, distribution, and characteristics of OSH injuries, illnesses, and exposures, NIOSH (in coordination with and input from OSHA, BLS, and the states) should establish a coordinated strategy and mechanism for timely dissemination of surveillance information.

- **Sub-recommendation O1:** *Clarify target populations for different types of surveillance information (e.g., rapid alerts, trends, and so on).*
- **Sub-recommendation O2:** *Establish a plan for accessing, integrating, and disseminating information from different surveillance sources.*
- **Sub-recommendation O3:** *Develop policies and criteria to address individuals' and employers' privacy and confidentiality considerations through a process that provides for stakeholder input and includes privacy experts in the development of these policies and in the design of surveillance systems.*
- **Sub-recommendation O4:** *Implement a coordinated information dissemination strategy, making use of different technologies as appropriate, to communicate information to those who need it to take action for prevention.*

This recommendation related to communication overlaps with many other sub-recommendations throughout the document. The dissemination of surveillance information is last in the continuum of functions, which include ongoing collection, management, analysis, interpretation, and dissemination. Ideally, the dissemination function can be used to drive

surveillance activities. This means assessing who will use surveillance information, what type of information they need, how they will use it, and how that use can be evaluated. Ultimately, the utility of surveillance information may be assessed by the extent that it is actionable to prevent occupational disease and injury and improve quality of life. This is predicated on the fact that the information is timely, and that the target audience receives it and can act on it to prevent adverse outcomes.

NIOSH maintains a comprehensive webpage with links to current surveillance initiatives: [NIOSH Worker Health Surveillance](#). Data and reports within each of the webpages are updated as appropriate by the programs supporting the initiatives. While this provides up to date data, it does not do so in a coordinated or consistent approach. We are evaluating visualization tools that will accomplish this objective.

CDC is also taking steps to utilize a standardized data dissemination strategy, using application programming interfaces and data visualization tools. Use of standardized technologies, such as application programming interfaces and centralized websites, can be leveraged to implement a coordinated information dissemination strategy.

NIOSH works with a number of different surveillance systems to monitor and report occupational injury and disease trends. There is no single system, making the creation of a comprehensive report challenging. Our plan to meet this recommendation is to create an interactive website that pulls from the different systems and presents the data in a consistent and flexible manner to the user. Data would be updated continuously, use visualization tools, and allow for download of periodic summaries or news releases. This database could also be used to develop routine surveillance spotlights that highlight actionable information. This would necessitate a dedicated small team of IT, surveillance, and communication specialists that would work across the Institute to develop and maintain the website. In the longer term, this team could also use social media to direct audiences to the website and use particular “stories” and targeted communications for specific populations. Important target audiences include employers, trade associations, insurance providers, suppliers, workers, labor organizations, governmental decision-makers, researchers, and public health and health care professionals.

Recommendation P: Prioritize and coordinate OSH surveillance.

NIOSH, OSHA, and BLS should work together to encourage education and training of the surveillance workforce in disciplines necessary for developing and using surveillance systems, including epidemiology, biomedical informatics, and biostatistics.

To address this recommendation, NIOSH, OSHA, and BLS should further discuss a potential approach to address the sub-recommendations below.

Sub-recommendation P1:

Identify the core competencies required for OSH surveillance and promote the science of surveillance.

A plan to approach this sub-recommendation may include working with experts to identify the competencies. In so doing, distinctions between “surveillance” vs. “data science” and “surveillance research” vs. “surveillance” should be made clear.

Sub-recommendation P2:

Review the curricula of existing surveillance courses.

Addressing this sub-recommendation may include these options:

- Contacting CDC’s Epidemic Intelligence Service (EIS) program to request information on their standard surveillance curriculum for their 1-month course in epidemiology for new officers.
- Conducting a survey of NIOSH ERCs and Training Project Grantees, Schools of Public Health, and recipients of state surveillance grants to identify classes that contain training on how to conduct surveillance.

Sub-recommendation P3:

Collaborate with educational organizations to establish or modify training programs accordingly.

Once the activities in sub-recommendation P2 above are completed, there may be opportunities through the ERC and Training Programs to influence training programs. The CDC Division of Scientific Education and Professional Development has had experience with an informatics training program; although this program is no longer active, NIOSH may investigate if there are available resources that could be useful. Adding surveillance skills to informatics training is another avenue that NIOSH may explore. The Public Health Informatics Fellowship Program may be useful in the future, when NIOSH has informatics experts in place to mentor fellows. In addition, NIOSH may explore opportunities through current collaborations with the health informatics training programs at Georgia Tech and the University of Cincinnati to add occupational health and safety topics to the curriculum.

Sub-recommendation P4:

Require surveillance courses in all funded training programs, especially in the Education and Research Center and Program Project training grants.

It is not possible for NIOSH to require this of ERCs or Training Program Grantees. The curriculum is governed by many other factors (i.e., accreditation bodies, university policies, degree programs), and NIOSH would not be able to require a change or an inclusion of a certain topic area. However, inclusion of surveillance in the curricula could be strongly

encouraged in the Funding Opportunity Announcement and NIOSH will explore this possibility.

Sub-recommendation P5:

Contribute to development of surveillance courses and conferences that provide training in surveillance method.

In the longer term, this could be accomplished in partnership with CSTE and ERCs. CSTE currently offers training for states.

Recommendation Q: Meta-recommendation

The Secretary of HHS, with the support of the Secretary of Labor, should direct NIOSH to form and lead a coordinating entity in partnership with OSHA, BLS, and other relevant agencies. The coordinating entity should

Develop and regularly update a national occupational safety and health surveillance strategic plan that is based on well-articulated objectives;

Coordinate the design and evaluation of an evolving national system of systems for OSH surveillance and for the dissemination of surveillance information provided by these systems;

Publish a report on progress toward the strategic plan's implementation at least every 5 years, documenting advances toward achieving a 21st Century Smarter Occupational Safety and Health (OSH) Surveillance System; and

Engage partners, including other federal health statistics agencies, state agencies with OSH responsibilities, and stakeholders.

HHS was briefed by the National Academies on the recommendations of this report. Although NIOSH has no control over the implementation of this recommendation, NIOSH will discuss this recommendation with OSHA and BLS.

References

Felknor SA, Schulte PA, Schnorr TM, Pana-Cryan R, Howard J [2019]. The BNI framework: burden, need and impact: an evidence based framework to identify worker safety and health research priorities. *Ann Work Expo Health*, 63(4):375–385, <https://doi.org/10.1093/annweh/wxz011>

Groenewold M, Brown L, Smith E, Sweeney MH, Pana-Cryan R, Schnorr TM [2019]. Burden of occupational morbidity from selected causes in the United States overall and by NORA industry sector, 2012: A conservative estimate. *Am J Ind Med* 2019: 1–18, <https://doi.org/10.1002/ajim.23048>

NIOSH [2016]. Overview of NIOSH surveillance. Prepared for May 31, 2016, National Academies Review, https://www.cdc.gov/niosh/topics/surveillance/pdfs/surveillance-briefing-document_8.6.19_508.pdf