NIOSH Disaster Science Responder Research Program

COVID-19 Research Agenda

Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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DEPARTMENT OF HEALTH AND HUMAN SERVICE
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Introduction

Given the rapidly evolving nature of the COVID-19 pandemic and response, the National Institute for Occupational Safety and Health (NIOSH) has developed a COVID-19 research agenda to address occupational health research gaps in the context of the COVID-19 response. This research agenda is a high-level framework for planning and prioritizing COVID-19 research recommended, conducted, or supported by NIOSH. It complements and expands on areas of occupationally related COVID-19 research addressed in the CDC Science Agenda for COVID-19.

Disaster Science Responder Research (DSRR) Program Background

Emergency response workers and others involved in response, remediation, and recovery efforts often perform non-routine activities in uncharacterized, potentially hazardous environments where they may encounter new exposures or have unexpected health effects. The health impact of these exposures and the factors responsible for them, whether immediate or delayed, represent a pressing public health need to characterize this worker safety and health environment.

In 2015, NIOSH established its Disaster Science Responder Research Program (DSRR) Program in the Emergency Preparedness and Response Office (EPRO) to address worker safety and health needs. The DSRR Program will develop an approach to timely, scalable, and scientifically sound research that can feasibly be implemented before, during, and after a disaster without interfering with the response itself.

The goals of the NIOSH DSRR Program are to: 1) identify important occupational research gaps for emergency response and recovery workers; 2) inform approaches for conducting research during a disaster; and 3) create mechanisms for overcoming the associated logistical, technical, and administrative challenges that researchers encounter during emergency responses. For the DSRR Program, response and recovery workers include all workers who may be affected by the emergency. For the COVID-19 pandemic, this includes, but is not limited to, healthcare personnel, first responders, correctional workers, public health personnel, meat and poultry processing workers, farm workers, airline and airport personnel, public transportation operators and other passenger drivers, grocery and food retail workers, and delivery drivers. While some disaster scenarios are best researched during an ongoing response, the program also aims to identify critical topic areas to address research gaps that can be studied outside the scope of an ongoing response.

Conducting responder health and safety research in the disaster environment requires researchers to address many challenges unique to public health emergencies. These challenges include the immediate emphasis on response activities, capabilities, and resources; safety of the teams conducting studies in hazardous environments; access to emergency response leadership who would need to approve research activities involving the response activities under their charge; the linguistic and cultural diversity of worker populations; and timely recognition of important occupational safety and health risks during the response or recovery operations.

Authorizing Legislation

NIOSH conducts research under the authorization of the U.S. Occupational Safety and Health Act of 1970, Section 20(a) and 21(a) (29 USC 669(a) and 29 USC 670); U.S. Federal Mine Safety and Health Act, Section 501(a), 30 USC 1 (Note), and 30 USC 951(a); and Section 301 of the U.S. Public Health Service Act as amended (42 USC 241) and under Federal Regulations 42 CFR Part 52.

COVID-19 Research Team Agenda Development Process

In March 2020, DSRR leadership identified nine critical topic areas (CTAs) based on emerging worker safety and health issues related to the COVID-19 response. The DSRR COVID-19 Research Team, consisting of NIOSH subject matter experts from each topic area, was formed to conduct a rapid review of the literature and to summarize the knowns, the unknowns, and the immediate science needs.

The COVID-19 research agenda is based on the research team's efforts to date. The team continues to evaluate new literature as it becomes available and will continue to revise and refine the NIOSH COVID-19 research agenda.

COVID-19 Critical Topic Areas

The agenda outlined below is organized by CTA. The agenda reflects the collective efforts of the DSRR COVID-19 Research Team to identify research gaps based on a rapid review of the COVID-19 literature conducted in 2020–2021. The agenda is a living document and will remain flexible to reflect the rapidly evolving occupational research needs of the current COVID-19 response. The goals listed under each CTA are in the order of priority. For some CTAs, a goal may identify needs that must be addressed before other goals within that CTA can move forward (e.g., methods/technologies first need to be developed or evaluated). In these cases, goals that depend on other goals are notated as a sub-bullet (e.g., 5.1, 5.1.1 for dependent goals). This document will be updated periodically to reflect changing NIOSH priorities. We realize many of the goals will help to address worker safety and health needs for other communicable and infectious diseases, but the current effort addresses COVID-19.

We emphasize that research priorities should focus on "essential workers" as those who conduct a range of operations and services in industries that are essential to ensure the continuity of critical functions in the United States. An Interim List of Categories of Essential Workers Mapped to Standardized Industry Codes and Titles is available. Essential workers were originally described by the U.S. Department of Homeland Security's Cybersecurity and Infrastructure Security Agency's Guidance on the Essential Critical Infrastructure Workforce: Ensuring Community and National Resilience in COVID-19 Response, (Version 4.0; August 18, 2020).

Equally important, COVID-19 research should identify and address the health disparities and inequities faced by workers in the United States. Worker populations of special focus include but are not limited to racial and ethnic minority groups, workers with limited English proficiency, workers with lower incomes, workers with disabilities and special needs, and immigrant workers. Evidence-based solutions are essential to address these disparities and improve the health outcomes of workers disproportionately affected by COVID-19.

The CTAs, listed in alphabetical order, addressed in the science agenda include:

- Economics
- Engineering Controls
- Epidemiology/Surveillance
- Mental Health
- Occupational Environmental/Exposure Assessment
- Occupational Violence
- Personal Protective Equipment
- Transmission/Occupational Health
- Zoonosis

1. Economics

Economic studies on worker safety, health, and well-being during and following the COVID-19 pandemic are needed. This research would help assess the effects of economic factors on the spread of COVID-19 and identify the most cost-effective prevention, mitigation, and support strategies for reducing the economic burden of the pandemic for workers and their families, employers, and society overall.

Priority Goals

1.1 Estimate the costs and benefits of strategies to protect and support workers during and following the COVID-19 pandemic from the worker, employer, and societal perspectives. Strategies include but are not limited to: addressing supply shortages; implementing lockdowns; testing; changes in work schedules and staffing; changes in work organization, including physical distancing; symptom and temperature screening; engineering controls; vaccinations; and using core social insurance programs (i.e., Social Security, unemployment insurance, and workers' compensation).

1.2 Assess the economic factors affecting compliance with prevention and mitigation strategies to protect workers. These would include economic barriers to compliance that relate to the ability to work remotely.

1.3 Identify the infection prevention strategies workers and employers prefer, in order to address differences in workers' and employers' perceptions of costs and benefits of prevention of COVID-19 in workplace settings.

1.4 Assess the optimal mix, in terms of costs and benefits, of prevention and mitigation strategies at the worker, employer, and societal levels of analysis.

1.5 Assess and track the economic burden of COVID-19 for workers and their families, employers, and society overall. This includes examining the disease itself, other illnesses and injuries, and well-being related to changes in income and employment due to the response to COVID-19 (e.g., lockdowns and physical distancing restrictions).

1.6 Assess the effects of pandemic-related economic factors, including changes in work organization and characteristics of work arrangements (e.g., employee status, access to fringe benefits including paid sick leave, ability to work remotely, and work schedule), as well as government-sponsored economic supports on worker and employer overall well-being.

1.7 Identify emerging trends (e.g., remote work and automation) due to or accelerated by the pandemic that may shape future of work issues (categorized by work, workplace, and workforce) and the potential consequences to economic status and well-being.

2. Engineering Controls

Engineering controls may protect workers from COVID-19 by eliminating or reducing possible exposures by adding or applying an engineered technology or solution. Examples include improved ventilation to dilute viral particles and modification of workstations, including use of physical barriers, to maintain worker separation. Literature has shown well-designed engineering controls may be highly effective in protecting workers from COVID-19 without reducing productivity or personal comfort.

Priority Goals

2.1 Evaluate the efficacy, safety design, and implementation strategies for emerging environmental intervention technologies (e.g., bipolar ionization, dry hydrogen peroxide, far-UV, blue light) and their application in full-scale HVAC systems and occupied spaces.

2.2 Evaluate the equivalent clean air exchange rates method for providing engineering control recommendations for different settings impacted by COVID-19. Develop recommendations for these various building occupancy types and other occupied settings, such as public transportation vehicles.

2.3 Evaluate the effectiveness of engineering controls for COVID-19 used in healthcare environments (e.g., high ventilation rates, air filtration, directional airflow, ultraviolet germicidal irradiation) when applied in non-healthcare work settings.

2.4 Develop new or evaluate available local source control methods, such as local exhaust ventilation and containment enclosures, to prevent worker exposures to SARS-CoV-2 from droplet transmission, fomite transfer, and aerosol-generating activities.

2.5 Develop new approaches or evaluate available non-ventilation approaches intended to reduce or prevent worker exposures to SARS-CoV-2, such as physical barrier protections, redesign of workstations and processes, and methods that inactivate the virus.

2.6 Evaluate the effectiveness of general ventilation controls for preventing or reducing exposures to SARS-CoV-2.

3. Epidemiology/Surveillance

Epidemiologic studies are needed to identify and characterize the impact of COVID-19 on U.S. workers whose jobs have been affected by the pandemic. Information on essential workers, such as healthcare personnel and critical infrastructure workers, is urgently needed. Currently, data for these workers are largely limited to those with confirmed COVID-19, smaller studies with single or multi-center facilities, and cross-sectional studies. There is a need for widespread, comprehensive, and long-term epidemiologic assessment focused on U.S. workers.

Priority Goals

3.1 Track and characterize SARS-CoV-2 infections in U.S. workers by industry and occupation groups in a systematic and representative way, so that reliable estimates of infection can be generated.

3.2 Capture occupational data by adding industry and occupation questions to case-reporting and laboratory-reporting forms of new and ongoing COVID-19 surveillance activities.

3.3 Evaluate the demographic characteristics and risk factors of workers, and the disparities in SARS-CoV-2 infection, disease severity, and mortality among occupational groups with high rates of infection, severe illness, and death from COVID-19.

3.4 Characterize SARS-CoV-2 infection rates or seroprevalence among workers in healthcare and critical infrastructure industries (e.g., meat and poultry processing, public safety, grocery, and other retail), and estimate incidence of workplace-acquired COVID-19 among these occupations.

3.5 Compare SARS-CoV-2 infection or seroprevalence rates among workers with various risk factors (e.g., close contact to cases, interactions with the public, PPE use and reuse by staff, use of cloth masks by customers, work hours, infection control training, implementation of engineering and administrative practices as part of infection control practices in the workplace, vaccination rates among employees).

3.6 Characterize and evaluate the effectiveness of the strategies that employers use to control infection in the workplace, including symptom screening, screening testing, respiratory protection, masking, physical distancing, isolation of cases, quarantine of close contacts, and vaccine incentives or workplace policies regarding COVID-19 vaccination.

3.7 Characterize employers' willingness, ability, and barriers to implementing testing, contact tracing, isolation and quarantine policies, and vaccination programs.

3.8 Characterize the sources of information employers use to develop infection control strategies for their workplace and communicate COVID-19 information to workers, and the sources of COVID-19 information workers use.

3.9 Evaluate effectiveness and appropriateness of health communication products among workers who might be at high risk of SARS-CoV-2 infection, who face

communication barriers such as low literacy or limited English proficiency, or who lack traditional employer-mediated sources of information, such as migrant or temporary workers in congregate living, wildland firefighters, day laborers, temporary workers, contractors, and gig workers.

4. Mental Health

The stress of living and working during a public health emergency may lead to adverse mental health outcomes among workers, such as post-traumatic stress disorder (PTSD), anxiety, depression, and other symptoms of severe stress. It might also increase workers' likelihood of using unhealthy coping strategies. During the COVID-19 pandemic, there is a need to rapidly identify workers or groups of workers at highest risk of developing anxiety-related disorders, PTSD symptoms, depression, or substance use disorder. Data on effective interventions to address mental health among workers are needed to mitigate harm to workers that might be caused or exacerbated by pandemic working conditions.

Priority Goals

4.1 Characterize changes (e.g., pre-pandemic versus during pandemic versus post-pandemic changes over time) in frequency and severity of mental health symptoms and diagnosed mental health disorders among U.S. workers by industry and occupation.

4.2 Characterize differences in frequency and severity of mental health symptoms and diagnosed mental health disorders by working conditions (e.g., teleworking, interacting with the public, access to and use of PPE, customer mask compliance, increased job demands and job stress, short- and long-term layoffs, termination).

4.3 Characterize the prevalence and incidence of substance use and substance use disorder among workers by industry and occupation, working conditions, and changes in work related to the pandemic (e.g., loss of employment, reduction in work hours, job insecurity).

4.4 Characterize the prevalence and incidence of self-harm or thoughts of self-harm among workers by industry and occupation, working conditions, and changes in work related to the pandemic (e.g., loss of employment, reduction in work hours, job insecurity).

4.5 Conduct efficacy studies of interventions (new or existing) to manage mental health and strengthen resilience of workers and provide real-time referral to care for those needing urgent support.

4.6 Characterize the level and impact of symptoms of burnout, job dissatisfaction, employee engagement, and employee turnover by occupational group, workplace characteristics, and impressions of safety climate among U.S. worker populations, with special attention to healthcare personnel and critical infrastructure workers.

4.7 Characterize the sources of concern or stress among workers due to COVID-19, including risk of infection in the workplace and employment-related consequences

of developing COVID-19 (e.g., loss of income due to unpaid leave, fear of job loss, fear of infecting household members, concerns about job security, distress related to teleworking while also providing caregiving).

5. Occupational Environment/Exposure Assessment

Assessment for the risk of SARS-CoV-2 exposure is fundamental to understanding the infectiousness in workplace settings and especially during aerosol-generating activities. Measuring infectivity of the virus in both aerosols and on surfaces and determining the viral concentration for comparison to an infectious dose (once known) is necessary to assess risk and make recommendations. Validated sampling and analytical methods need to be developed to ensure results can be consistently interpreted and applied to protect workers. Laboratory studies are ideal for quickly assessing transmission pathways and evaluating sampling and analytical methods in various environmental conditions and with animal models.

Priority Goals

5.1 Determine if a validated air sampling collection and analytical method for infectious SARS-CoV-2 virus is feasible and whether it is needed to assess the role of short-range aerosols containing SARS-CoV-2 in transmission.

5.1.1 Identify or develop personal breathing zone and area (stationary) size-selective aerosol characterization, collection, and analytical methods to quantify number, air concentration, and size distribution of respiratory tract-derived airborne particles containing viable, infective SARS-CoV-2. Optimize these sampling and analytic methods for accuracy, bias, precision, and limit of detection, and then validate the most promising methods.

5.1.1.1 Using validated methods, characterize the number and sizes of particles containing viable (infective) SARS-CoV-2 from aerosol-generating medical procedures. Identify modifications to procedures that can reduce or eliminate generation of infectious aerosols.

5.1.1.2 Using validated methods, characterize the number and size range of respiratory tract-derived particles containing viable (infective) SARS-CoV-2 generated by various exhalatory events (e.g., breathing, talking, singing, playing specific musical instruments) and account for human-to-human variability.

5.1.1.3 Using validated methods, determine which size droplets/aerosols are infective and for how long, and how environmental conditions affect the duration of viability/infectiousness, such as temperature, humidity, and sun exposure.

5.2 Determine the effectiveness of source control methods (e.g., N95 respirators, surgical masks, cloth masks) for containing the virus and how the use of these devices affects exhaled droplet and aerosol transmission and flow patterns.

5.3 Determine the modes of transmission and document the quantitative dose-response relationships for causation of infection and disease by SARS-CoV-2 via the various modes of transmission (small aerosol versus droplet versus direct contact) using well-validated animal models (e.g., ferret).

6. Occupational Violence

Occupational violence includes verbal and physical abuse, homicides, and suicides. COVID-19-related occupational violence assessments must recognize changing risk factors related to disease prevention efforts and unprecedented unemployment and financial loss. Methods should be developed to track violence patterns, assess contributing factors, and identify prevention strategies related to the pandemic.

Priority Goals

6.1 Identify new or improved surveillance methods, data sources, or tools to monitor and describe the incidence of occupational violence related to COVID-19.

6.2 Characterize nonfatal occupational violent events related to COVID-19.

6.3 Characterize fatal occupational violent events related to COVID-19.

6.4 Assess the effectiveness of mitigation measures to reduce occupational violence events related to COVID-19 and describe any barriers to their implementation/enforcement.

7. Personal Protective Equipment

Personal protective equipment (PPE) such as respirators, gloves, gowns, and face shields is the last line of defense in the hierarchy of controls but is sometimes the main way to protect workers. The design and development, testing and evaluation, and use of PPE are needed to protect all workers, especially first responders and healthcare personnel during both routine patient care and infectious disease outbreaks and pandemics such as COVID-19.

Priority Goals

7.1 Develop and evaluate methods (such as reuse, extended use, and decontamination) to optimize the use of PPE during supply shortages.

7.2 Assess the physiological burden and comfort of workers practicing reuse, extended use, and decontamination of their PPE during supply shortages.

7.3 Develop new or improve existing standardized procedures for measuring the effectiveness of PPE in preventing exposure to viral pathogens.

7.4 Identify and evaluate novel materials and construction of PPE to determine their usability over extended time periods in a variety of environmental conditions.

7.5 Assess effects of shortages of PPE and implementing PPE supply optimization strategies, such as reuse, extended use, and decontamination, on health and safety of workers during times of shortages.

7.6 Evaluate the ability of surgical masks, medical masks, and cloth masks to reduce inhalation of aerosols.

7.7 Evaluate the role and effectiveness of PPE to reduce transmission of SARS-CoV-2 to workers in healthcare and non-healthcare settings.

7.8 Develop standardized methods or novel sensors for point-of-use evaluation of PPE performance, including respirator fit, PPE contamination levels, or other hazards requiring changes in PPE use or practices.

7.9 Conduct intervention research to support healthcare provider and emergency responder education about PPE selection, use, care, and maintenance.

7.10 Develop or improve test standards for the evaluation of PPE performance.

8. Transmission/Occupational Health

This CTA includes multidisciplinary research to clarify the details of SARS-CoV-2 transmission in work settings that can be used to inform prevention efforts. It also includes multidisciplinary research (e.g., laboratory and clinical research, demonstration projects, epidemiological investigations and field studies, and economic evaluations) to translate advances in prevention, diagnosis, and treatment of COVID-19 into improved occupational health interventions. This will enable workplaces to function by preventing workplace transmission of infection and meeting the needs of those recovering from COVID-19.

Priority Goals

8.1 Develop and demonstrate improved methods for screening to identify people with SARS-CoV-2 infection who should not enter workplaces until they do not pose a risk of infectiousness. Examples might include improved screening for signs and symptoms of respiratory disease, using point-of-care viral tests to screen individual workers for active SARS-CoV-2 infection, developing new approaches to identify people who are at increased risk for infectiousness (as opposed to infected), or using pooled testing to evaluate for active SARS-CoV-2 infection in worker populations.

8.2 Develop and demonstrate effective approaches to coordination between employers and state, tribal, local, and territorial health departments to report cases, conduct workplace case investigations and contact tracing, and deliver services, such as COVID-19 testing and vaccinations.

8.3 Track workers' acceptance of COVID-19 vaccination and identify approaches to overcome workers' COVID-19 vaccine hesitancy. Optimize vaccine uptake in high-priority worker populations with attention to the diverse needs of workers regardless of racial/ethnic groups, socioeconomic status, immigration status, country of birth, educational level, or primary language.

8.4 Identify risk factors in some work settings that are conducive to the "super-spreading" events that are thought to be responsible for a large proportion of SARS-CoV-2 and other respiratory infections.

8.5 Develop methods to prevent conditions in work settings that enable super-spreading and prospectively identify people in workplaces who are at increased risk for becoming super-spreaders.

8.6 Evaluate and compare effectiveness of practices for implementing, and innovations to better implement, effective mask wearing and physical-distancing policies in work settings.

8.7 Evaluate and compare effectiveness of practices for supporting workers who are diagnosed with COVID-19 and are required to isolate and those who are identified as close contacts of people with COVID-19 and are required to quarantine before returning to work.

8.8 Track the prevalence and risk factors for long-term sequelae and chronic impairment and disability caused by SARS-CoV-2 infection in workers; ascertain implications for returning to work, including reasonable accommodation; develop, evaluate, and demonstrate effective practices to assess fitness for duty and to evaluate for chronic impairment due to COVID-19; and help workers with chronic impairment to return to work.

8.9 Assess the effectiveness of COVID-19 vaccination in preventing SARS-CoV-2 infection and disease in worker populations identified as being at increased risk for occupational exposure to SARS-CoV-2, such as those who must work in close proximity to others or those who live in congregate settings.

9. Zoonosis

More research is needed to investigate the animal species that are susceptible to SARS-CoV-2 infection and whether there may be a potential zoonotic workplace risk to veterinary and other workers who may interact with animals. Surveillance of animals in close contact with workers provides important public health information about virus transmission from humans to animals and whether transmission from animals to humans may be a concern from some animal species in certain work environments. Research is needed to understand how to protect veterinary and animal workers from potential zoonotic exposures to SARS-CoV-2.

Priority Goals

9.1 Conduct surveillance of SARS-CoV-2 infections in animals where there is close worker contact and potential zoonotic concern, including species reported to have disease outbreaks associated with SARS-CoV-2 infection (e.g., farmed mink) and species with known or predicted susceptibility to SARS-CoV-2 (e.g., non-human primates, felines, mustelids, hamsters, and transgenic mice expressing the human ACE2 receptor).

9.2 Conduct studies focusing on susceptible animal species and the potential for occupational zoonotic risk to workers.

9.3 Investigate domesticated and production animals as potential reservoirs and sources for zoonotic transmission of SARS-CoV-2 to workers, including the reported role of farmed mink, potential role of related captive mustelids, and potential role of domestic cats in the spread between farms.

9.4 Determine effective prevention measures to protect workers in close contact with animals from potential zoonotic SARS-CoV-2 exposures.

9.5 Investigate the role of wildlife species as potential reservoirs and sources for zoonotic transmission of SARS-CoV-2 to workers.

Promoting productive workplaces through safety and health research

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