away from work from transportation incidents was 26.9 per 10,000 workers in transportation and warehousing sectors, the highest rate in 5 years, and 5 times the rate for all private industry workers.

Interactions between workers and machines in TWU have been beneficial to the employer and worker by reducing workload, repetitive tasks, and increasing production capabilities. The International Federation of Robotics reports sharp increases in sales and is projecting that a new type of robot, collaborative robots that work alongside and in conjunction with human workers, will have a market breakthrough in the next several years. Wearable robotics, such as exoskeletons to reduce physical loads on workers, are being marketed and have the potential to reduce musculoskeletal disorders among TWU workers. Vehicles increasingly have automated safety features, and fully autonomous vehicles, including commercial trucks and transit vehicles, are currently being piloted on U.S. roadways. Technologic advances have the potential to improve safety in many areas. However, the pace of these technologic advances increases the potential for unforeseen hazards being introduced in the workplace.

The demands of many TWU jobs make it difficult to lead a healthy lifestyle. Psychosocial stressors and the work demands of TWU workers create special challenges: tasks may be sedentary in nature, limited options may be available for where and when to eat, including access to healthy food choices, sleep periods may be suboptimal, and work arrangements may be nonstandard. TWU workers have a high prevalence of obesity. Obesity is a risk factor for chronic disease that manifests itself in health conditions such as metabolic syndrome, cardiovascular disease, obstructive sleep apnea, and diabetes; premature death and disability; increases in health care costs; lost productivity; and social stigmatization. From 2004 to 2013, 34% of TWU workers reported being obese (Body Mass Index >30) and 26% reported ever being diagnosed with hypertension, and just 45% of TWU workers met CDC guidelines for physical activity. These same data showed that only 74% of TWU workers had seen a primary health care provider in the 12 months prior to being interviewed.

The TWU program collaborates with partners to identify relevant research and to help disseminate research findings and translate them into practice. The program publishes research in scientific journals and translates findings into materials that can be used by a variety of partners and stakeholders to improve the safety, health, and well-being of TWU workers. Products include scientific journal articles, fact sheets, blogs, infographics, and social media messages.

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H-4

NIOSH—Wholesale and Retail Trade Program

Deborah Hornback (NIOSH)

The National Institute for Occupational Safety and Health (NIOSH) Wholesale and Retail Trade (WRT) Program provides leadership to prevent diseases, injuries, and fatalities in wholesale and retail trade workers. Through our partnerships with industry, labor, trade associations, professional organizations, and academia and research efforts, we focus on the following areas:

- Reducing injuries and illnesses from overexertion and adverse bodily reactions especially among aging workers and those who are exposed to the safety risks from emerging technologies
- Preventing injuries from slips, trips, and falls
- Reducing motor vehicle-related injuries

In 2017, the WRT sector employed over 20 million workers in 1.4 million establishments. In 2017, the WRT sector accounted for 553,800 injuries and illnesses or 19% of the total injury/illness cases reported to the Bureau of Labor Statistics (BLS) by private industry employers. Over 60% of those recordable cases, about 337,000, were severe enough that employees experienced combinations of illnesses and injuries that require days away from work, job transfer, or restriction. The disproportionate number of recordable nonfatal injuries and illnesses, given the size of the work population, may be attributed to a set of high-risk subsectors within the WRT sector. These subsectors may include: food and beverage stores, general merchandise (stores), grocery and related product merchant wholesalers, motor vehicle and parts dealers, and building/gardening materials and supplies, among others. BLS selected events or exposures that attributed nearly 90% of recordable nonfatal injuries and illnesses are from overexertion and bodily reaction, contact with objects, or falls, at all levels. WRT had higher incidence rates for these events or exposures than all private industry.

The WRT sector experienced 461 fatalities in 2017. The highest number of fatalities in wholesale were due to transportation incidents and in retail were due to violence, and other injuries by person or animal. We conducted an evaluation of BLS data in whole years from 2006 through 2016 for workplace fatalities and recordable nonfatal injuries and illnesses by selected events or exposures. The wholesale sector incidence rate was consistently higher than all private industry during the eleven-year interval. The retail sector recordable nonfatal injuries and illnesses incidence rates were also higher than all private industry during this time. We analyzed BLS demographic data on age, race and ethnicity, and gender to determine the characteristics of the WRT population and how they compare to other industry sectors.

This study is the most up-to-date and comprehensive assessment of WRT morbidity, mortality and injury. It will serve as the basis for future research and prevention efforts.

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H-5

NIOSH—Chronic Disease Cross Sector of NORA Council: Identification and Prevention of Occupational Disease

Todd Stueckle (NIOSH)

Occupational chronic diseases, including cancer and cardiovascular disease (CVD), remain an important source of economic cost and suffering. Similarly, some reproductive, neurologic, and renal diseases have occupational associations. The mission of the Cancer, Reproductive, Cardiovascular and Other Chronic Disease Prevention Program (CRC) is to provide national and international leadership for the prevention of work-related diseases using a scientific approach to gather and synthesize information, create knowledge, provide recommendations, and deliver products and services to those who can affect prevention. CRC includes projects addressing a wide variety of health endpoints. The concentration of the program's projects includes work-related research related to many types of 1) occupational cancer, 2) adverse reproductive outcomes related to work, and 3) CVD among workers. Additionally, CRC is the NIOSH program that includes projects related to occupational neurologic and renal diseases as well

as other chronic conditions or illnesses not identified elsewhere in the program portfolio. Evidence of burden, need, and impact are used to identify priorities to help guide research efforts towards preventing occupational disease.

Occupational carcinogens include single agents, complex mixtures, and high-risk occupational groups. Numerous epidemiological studies of specific exposures or specific industries have documented elevated risks for cancer among workers. Data for exploring occupation-related cancers is available via surveillance systems. For example, the NIOSH National Occupational Mortality Surveillance System allows investigators to identify associations of cause-specific mortality with occupation and industry. A vast number of carcinogens possess either unknown or understudied cancer risk. Cohort tracking can assess how interventions succeed to reduce exposures and subsequent effects. New data on emerging hazards, such as nanomaterials, are continuously sought after by the CRC to evaluate for cancer risk. Exposure, mechanism(s) of adverse effects, and risk from studies of high-priority agents are provided for quantitative risk models and recommendations. NIOSH continues to identify links between workplace exposures and cancer. A recent study of 30,000 firefighters reported higher rates of several cancers compared to the whole US population. Subsequently, a National Firefighter Registry was initiated in 2018 to improve understanding of cancer risk among firefighters.

Occupational exposures and the potential effects on reproductive health are of significant public health concern. Heavy metals, solvents, sterilants, gases, and pesticides are known agents that can impact reproductive outcomes in workers. Currently, 10% to 20% of pregnancies result in spontaneous abortion with 3% of live births possessing major malformations. Toxicant, multiple factors, and unknown causes are attributed to these effects. Some progress has been made to identify and separate occupational hazards from other etiologic factors associated with adverse reproductive outcomes. Many substances have suspected detrimental effects on reproductive processes, however, sufficient data are lacking. Laboratory studies inherently cannot keep pace to identify potential hazards and the underlying biological mechanisms. Recent advances in technology and methodology in reproductive health research are improving researchers' ability to 1) overcome obstacles, 2) improve understanding of causation, mechanism, and affected populations, and 3) reduce reproductive adverse outcomes.

Heart disease is the largest contributor to mortality in the U.S. totaling >647,000 in 2017. Little information exists, however, on how occupational hazards contribute to CVD risk and mortality rate. Although several agents in the workplace can affect heart health, clear links between occupational factors and disease development are not clear. For example, elevated rates of CVD death exist in non-smoking workers exposed to environmental smoke. More epidemiological research with available worker populations and collected biological specimens is clearly needed to identify occupational factors contributing to CVD among workers. Improved monitoring and measures of stress were recently shown to identify and improve understanding of key factors in the work environment contributing to CVD risk. New method development in exposure measurements, Quality of Work Life Surveys, and laboratory effects studies continue to improve detection of exposure and identify sub-clinical effects on the cardiovascular system. Research is improving our knowledge on how occupational factors impact biological mechanisms underlying workplace-associated CVD development.

Neurotoxicity leading to clinical syndromes represents one of the leading occupational disorders in the U.S, with a large proportion of hazardous agents possessing potent neurotoxic effects. Neurodegenerative diseases, peripheral neuropathies, and chronic encephalopathies have known associations with occupational exposures, such as pesticide and welding fume exposures. Also, a global epidemic of chronic kidney disease with unknown cause (CKDu) is occurring. Agricultural and other high work load industries are the most affected and factors including heat stress, dust, and pesticide exposures may play a role. Both exposure and chronic effects studies are needed that span across job tasks, genetic susceptibilities, and pesticide class. Evidence-based interventions, such as practices and programs, is needed to help minimize and prevent pesticide exposures. NIOSH-sponsored surveillance programs are beginning to elucidate the level of CKDu burden and etiologic mechanisms in U.S. workers. Partnerships, including researchers, workers, and industries, are starting to make progress in basic etiology, prevention, and translation research to reduce morbidity in affected occupational sectors.

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H-6

NIOSH—Development of the National Occupational Research Agenda (NORA) for the Immune, Infectious and Dermal Disease Prevention Program

Stacey Anderson (NIOSH)

NORA is a program sponsored by NIOSH to stimulate innovative research and workplace interventions. NORA councils are a venue for individuals and organizations with common interests to come together to identify national occupational safety and health research objectives. These build from advances in knowledge, address emerging issues, and are based on council member and public input.

The Immune, Infectious and Dermal Disease Prevention Program (IID) focuses on work-related diseases such as irritant and allergic contact dermatitis, allergic rhinitis, asthma and infectious disease, caused by work-related exposures. Also included are exposures to chemicals that can be absorbed from contact with skin that may result in adverse health impacts.

The NORA Council for IID has identified 6 objectives. (1) Investigate effects of recurring low-level occupational exposures on dermal, immune, and infectious diseases, including the role of perturbations on skin microbiome in maintenance of skin barrier function and toxicity resulting from xenobiotic metabolism by the skin and skin microbiome. (2) Investigate the contributions of skin exposure to the overall body burden of toxic substances including advancements in skin permeation measurements, modeling and refinement of skin exposure and risk assessment strategies. (3) Improve current skin exposure measurement methods including the quantification of chemical loading on the skin surface, characterization of dermal absorption or permeation, efficacy of workplace controls for dermal exposures and skin and surface decontamination methods. (4) Reduce the incidence and transmission of infectious disease in the workplace though assessment of exposure pathways, quantitative models, surveillance and intervention and preparedness. (5) Reduce the incidence of allergic disease in the workplace through the identification of allergens, understanding of the mechanisms of allergic disease and through surveillance, intervention and dissemination. (6) Investigate autoimmune disease risk associated with occupational and environmental exposures through

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