

Close Out Report
University of Massachusetts Lowell
Occupational Health and Safety TPG

for the period 7/1/2015 – 6/30/2020

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II. List of Abbreviations

ABET	Accreditation Board for Engineering and Technology
CPH-NEW	Center for the Protection of Health in the New England Workplace
CWEND	Center for Work, Environment, Nutrition & Human Development
FCOE	Francis College of Engineering
GESH	Global Environmental Sustainability and Health
LCSP	Lowell Center for Sustainable Production
MPH	Master's of Public Health
MSD	Musculoskeletal Disorder
NIOSH	National Institute for Occupational Safety and Health
Occ Epi	Occupational Epidemiology
OEH-IH	Occupational and Environmental Hygiene – Industrial Hygiene
OSH	Occupational Safety & Health
OS/E	Occupational Safety & Ergonomics
ScD	Doctor of Science
CHS	College of Health Sciences
TPG	Training Program Grant
TURI	Toxics Use Reduction Institute
TWH	Total Worker Health
UConn	University of Connecticut
UMass	University of Massachusetts
UML	University of Massachusetts Lowell
WE	Work Environment
ZCHS	Zuckerberg College of Health Sciences

III. Abstract

The Work Environment Training Program in Occupational Safety and Health at the University of Massachusetts Lowell, during the period 2015 to 2020, provided program support for four training programs: 1) Occupational Epidemiology (Occ Epi), 2) Occupational Safety/Ergonomics (OS/E), 3) Occupational and Environmental Hygiene-Industrial Hygiene (OEH-IH), and 4) Work Environment Policy/Cleaner Production. Since Fall 2019, the TPG supports trainees in two programs: 1) Occupational Epidemiology, where students receive an MPH with an option in Epidemiology awarded from the Zuckerberg College of Health Sciences; and 2) Occupational Safety/Ergonomics, where students receive an MSE in Industrial Engineering awarded from the Francis College of Engineering. A total of 30 masters and doctoral students were supported during this five-year cycle: eleven in Occ Epi, five in OS/E, eleven in OEH-IH, and three in Policy.

This TPG has been funded by NIOSH since 1990, with support at the master's and doctoral level for each program. At the beginning of this 5-year cycle the TPG was housed in the Department of Work Environment; it is now housed in the Department of Biomedical Engineering, with strong collaboration with the Public Health and Industrial Engineering graduate degree programs. The mission of the program remains unchanged: to train work environment professionals and conduct research on the identification and evaluation of safety and health hazards and the design of safe and efficient alternatives, thereby promoting the development of healthy and sustainable workplaces. In this mission, we are guided by an overarching vision to design and promote systems of production that are environmentally-sound, safe, healthy and rewarding for workers, communities, and consumers. Our integrated approach to health and safety strives to answer the basic question, "What is the optimal design of a healthy workplace, and how can it be achieved?"

The program's curriculum has four broad academic objectives: (1) recognition and evaluation of occupational safety and health hazards, especially ergonomic problems; (2) control and prevention of occupational safety and health hazards; (3) an understanding of the methods by which human health effects of working conditions are studied; and (4) U.S. labor relations and legislative context, as well as social and economic policy innovations that could further workforce well-being. Graduates of the Work Environment program include many successful practitioners and researchers whose careers in occupational safety and health indicate overall success towards these goals.

Trainees in both degree programs are required to complete a three-course core, comprising: Work Environment Policy & Practice; Ergonomics & Work, and Epidemiology & Biostatistics. All students also conduct an occupational health & safety project for their practicum (Public Health) or capstone (Industrial Engineering). Multiple extracurricular learning opportunities are available and foster inter-disciplinary exchange among the trainees, as well as professional development and networking with alumni.

IV. Significant Results / Impact

For the period 2015 to 2020, the Work Environment Occupational Safety and Health Training Program Grant provided program support for four training programs: a) Occupational Epidemiology (Occ Epi), b) Occupational Safety/Ergonomics (OS/E), c) Occupational and Environmental Hygiene-Industrial Hygiene (OEH-IH), and d) Work Environment Policy. This TPG has been funded by NIOSH since 1990, with support at the master's and doctoral level for each program. A total of 30 masters and doctoral students were supported during this five-year cycle: eleven in Occ Epi, five in OS/E, eleven in OEH-IH, and three in Policy. Each program is described in a separate section below.

Highlights: Occupational Epidemiology

The Occupational Epidemiology NIOSH traineeship incorporates an understanding of core OSH issues and applications. Occupational health studies place heavy emphasis on the quantification of exposure because control of exposure is often the first line of defense against workplace hazards. Both the design and the evaluation of exposure control strategies – from the setting of health standards to the choice of personal protection equipment, to the design and evaluation of engineering controls - require quantitative exposure-response information. Methods to generate such information, and the issues that arise in their application, are an important component of the UML approach to occupational epidemiology. There is a growing emphasis in the OSH field on formal evaluation of the effectiveness of control technologies and other workplace interventions, and occupational epidemiologists need to know how to design studies to evaluate these. One example of the growing need for such skills is the NIOSH Total Worker Health® program, which calls for examination of the opportunities, limitations, health benefits and cost-effectiveness of integrating OSH programs with other workplace efforts to improve worker well-being.

Discussions of mechanism often underlie choice of the optimal analytic approach to complex questions such as the health effects of prolonged sitting vs standing, population health impacts of the changing nature of work, potential impacts of workplace injury on opioid use, and interaction between job stress and low socioeconomic status. Thus a rigorous presentation of methodology is as essential in occupational epidemiology as it is in any other specialization within this field.

The application of methodology to substantive real-world problems also serves to highlight common work-related conditions that are not always considered of interest in general epidemiology programs. For example, the study of musculoskeletal disorders has been emphasized in this program because they account for such a large proportion of all work-related morbidity. This creates an interest in the study of episodic and reversible conditions, something often not covered in standard epidemiology programs. Similarly, the epidemiologic approach is extended to investigation of various types of acute injuries, through modern designs such as case-crossover studies and hierarchical regression methods.

Another emphasis is the analysis of surveillance data. Public health surveillance is related to etiologic epidemiology, but too often epidemiologists presented with routinely collected surveillance data attempt to analyze them as if they come from a formally designed study of a specific risk factor. Through case studies and practicum projects, students learn to appreciate how surveillance programs can be used for occupational health hazard identification and prevention.

Professional epidemiologists focusing on occupational problems need not only an understanding of their science, but also how to manage studies in the high-stakes environment of labor/management relations. The students learn that occupational epidemiology has often been caught in the middle of contentious policy debates; this brings the issue alive and motivates discussion and debate on the proper role of science and of the scientist. Critical thinking about risk assessment and the application of epidemiologic results to policy-setting are also motivated.

Field epidemiology experience for master's degree students is provided through capstone projects and internships. Important providers of these experiences include NIOSH-funded

research projects such as the Center for the Promotion of Health in the New England Workforce (CPH-NEW), one of the first two Centers of Excellence in Total Worker Health®; and the Safe Homecare Project, part of the Lowell Center for Sustainable Production. Field opportunities are also available through the state departments of public health and labor in Massachusetts and New Hampshire; and the Massachusetts Toxics Use Reduction Institute (TURI). Exposure to clinical case experience is available through colleagues at Harvard University and the University of Connecticut. Some of these centers are described below.

The Center for the Promotion of Health in the New England Workplace (CPH-NEW), Co-Directors: Laura Punnett and Martin Chorniack. CPH-NEW evaluates multiple models for integrating health promotion with occupational health interventions, with a strong emphasis on musculoskeletal, cardiovascular, and mental health outcomes; the underlying role of work organization; and the importance of worker involvement in program design and implementation. The key entities are the Work Environment TPG and all of the affiliated academic departments at the University of Massachusetts Lowell, the Department of Occupational and Environmental Medicine at the University of Connecticut Health Center (UHC), and the Departments of Psychology and Allied Health Science/Health Promotion at University of Connecticut Storrs. (URL: <http://www.uml.edu/Research/centers/CPH-NEW/>).

The Toxics Use Reduction Institute (TURI), Co-Directors: Michael Ellenbecker, Christopher Hansen and Joel Tickner. TURI provides resources and tools to help make Massachusetts a safer and more sustainable place to live and work. Established by the Massachusetts Toxics Use Reduction Act (TURA) of 1989, TURI collaborates with businesses, community organizations and government agencies to reduce the use of toxic chemicals, protect public health and the environment, and increase competitiveness of Massachusetts businesses (URL: <http://www.turi.org/>).

Lowell Center for Sustainable Production, Director: David Kriebel. The long-term goal of the Lowell Center for Sustainable Production (LCSP) is to integrate environmentalism and occupational health and safety while also demonstrating how these are compatible with new systems of production and consumption that are healthy for workers, environmentally sound, economically viable, and socially accountable. Through its solutions-oriented and collaborative research projects, the LCSP has become an internationally recognized resource for developing and piloting the concepts of sustainable production and consumption. Faculty, staff and students at LCSP help organizations find practical solutions to urgent environmental health and safety problems. The Center also forms partnerships with and draws upon the expertise of government officials, industry managers, private consultants, public interest groups, community groups, and faculty, staff, and students from throughout the University of Massachusetts Lowell and other universities. The LCSP has several projects with direct occupational health impacts including the Safe Home Care Project, the Sustainable Hospitals Program and a recent report: Lessons Learned: Solutions for Workplace Safety and Health (URL: <http://www.sustainableproduction.org>).

NIOSH support for focused, interdisciplinary training in epidemiologic study of the work environment is particularly appropriate because academic epidemiology programs often do not incorporate the special circumstances of workplace health and safety research. In our experience, many epidemiologists who graduate from traditional public health programs and subsequently develop an interest in occupational studies have limited backgrounds in relevant work environment disciplines, such as occupational hygiene and ergonomics. We believe that

the special focus of this training program prepares graduating epidemiologists to play a particularly effective role. Public agencies responsible for regulation, public health services, and research institutions directed at workplace health and safety policy-setting all benefit by hiring our graduates who are educated in how the particular features of the workplace impact everything from data collection to translation of findings into practical measures for health protection.

The Occ Epi training program went through significant administrative and academic changes during the last five years. The Department of Work Environment, which had housed the TPG for its first 26 years, merged with another department to form the Department of Public Health prior to the Fall of 2016. In January of 2018, Drs. Bryan Buchholz and Laura Punnett both moved to the newly formed Department of Biomedical Engineering in the Francis College of Engineering (FCOE). In fall of 2018, Dr. Buchholz became PI of the TPG. Dr. Punnett is the current Program Director for the Occ Epi program. The Occ Epi program is supported by faculty in Biomedical Engineering, Public Health, and Nursing.

Trainees in the Occ Epi program, as in the other WE training programs, are required to complete a three-course core: Work Environment Policy & Practice; Ergonomics & Work and Epidemiology & Biostatistics. In addition, all trainees are required to attend seminars on a broad range of occupational health & safety topics and will need to complete an occupational health & safety project for their master's practicum.

A semi-annual research symposium has been organized since 1998 by the UML and the University of Connecticut faculty and research staff. The occupational medicine program at UConn Health Science Center (Farmington) is a particularly valuable partner for Work Environment trainees. Students, staff and faculty from both universities who are working on occupational health and safety topics attend this day-long event held in Sturbridge, MA, halfway between the two campuses to present and discuss work in progress. Occupational psychology faculty and graduate students from the main UConn campus at Storrs also participate, broadening the scope of discussion even further. All NIOSH OccEpi trainees are expected to attend at least one of these semi-annual Sturbridge research symposia during their graduate studies.

During the last five years, the Occ Epi program graduated eight trainees who received an MPH or MS and three trainees who received a ScD degree. Since 1990, it has supported 30 trainees who received a master's and 17 who received a ScD degree.

Highlights: Occupational Safety/Ergonomics

This program provides the only comprehensive academic training in occupational safety / ergonomics in the New England region. It has been one of the broadest such programs in the nation, with a highly integrated curriculum that introduces students to the core OSH areas and trains them as real-world problem-solvers on behalf of worker health and safety. As described below, topics included within the core and OS/E program include introductions to safety engineering, ergonomics and human factors, biomechanics, laboratory and field methods for job analysis, and epidemiologic aspects of acute injury and musculoskeletal disorders. The collaboration with Mechanical Engineering has added courses in automation and robotics to the curriculum, permitting hands-on examination of the effect of workplace modernization on safety.

An additional way in which our definition of occupational ergonomics is more comprehensive than most is that it is not limited to biomechanical risk factors for MSDs. While this is obviously an important area, the basic concept of “fitting the task to the person” implies a much broader perspective. Work environment factors relevant to MSDs are not limited to heavy lifting and repetitive hand motions; the roles of thermal extremes and psychosocial strain have also been documented. In turn, many types of health effects besides MSDs can result from excessive physical workload and psychosocial strain, such as acute injury, heart disease, psychological disorders, and adverse reproductive outcomes from exposures during pregnancy.

Further, because OS/E students also learn the basic principles of epidemiologic research, they learn to appreciate their own potential contributions to exposure assessment in studies of musculoskeletal disorders (MSDs) and acute injury. As discussed also under the Occ Epi program, accurate quantification of exposures is fundamental to developing threshold limits and informing appropriate hazard control technologies. The OS/E curriculum includes a variety of exposure assessment methodologies, discussed in the context of the differing needs of researchers and practitioners; and it presents the current status of guidelines and standard-setting within a broad framework that encompasses both the scientific state of the art and the socio-political or Work Environment Policy context. This applies to acute injury risk, as well, which is still far too rarely studied with modern epidemiologic methods.

The goal of the academic program in OS/E is to provide students with an appreciation of the interactions among the many features of the work environment and with the capability to evaluate and control the relevant risk factors for acute workplace injury, musculoskeletal disorders, and the other human health effects that result from a poor fit between the worker and the workplace. As a consequence, our students will acquire a solid foundation in the public health principles and methods that are necessary for comprehensive risk reduction, as well as a full appreciation of the breadth of their future professional responsibilities. This will give them a unique health protection approach to safety/ergonomics and an ability to keep up with future advances in relevant areas.

The Center for the Promotion of Health in the New England Workplace (CPH-NEW), Co-Directors: Laura Punnett and Martin Cherniack. UML is home to one of six national NIOSH *Total Worker Health*® (TWH) Centers of Excellence. The key entities are the Work Environment TPG and all of the affiliated academic departments at the University of Massachusetts Lowell, the Department of Occupational and Environmental Medicine at the University of Connecticut Health Center (UCHC), and the Departments of Psychology and Allied Health Science at University of Connecticut Storrs. (<http://www.uml.edu/Research/centers/CPH-NEW/>).

The TWH program calls for examination of the opportunities, limitations, health benefits and cost-effectiveness of integrating health protection programs with other strategies for improving

workforce health and wellbeing. CPH-NEW puts a strong emphasis on musculoskeletal, cardiovascular, and mental health outcomes; the underlying role of work organization; and the importance of worker involvement in program design and implementation. There is an evidence-based orientation toward work organization characteristics as underlying or upstream determinants of both OSH hazards and personal or “lifestyle” behaviors (smoking, leisure-time inactivity, etc.). Further, the CPH-NEW approach to implementing TWH programs is heavily informed by the participatory ergonomics literature. Thus, the systems approach which underlies the safety and ergonomics curriculum has also been put into practice within this research initiative. Many OS/E students have benefited from exposure to these concepts not only in the classroom but also as research assistants and in their master’s projects or dissertations.

The OS/E program went through significant administrative and academic changes during the last five years. The Department of Work Environment, which had housed the TPG for its first 26 years, merged with another department to form the Department of Public Health prior to the Fall of 2016. In January of 2018, Drs. Bryan Buchholz and Laura Punnett both moved to the newly formed Department of Biomedical Engineering in the Francis College of Engineering (FCOE). In fall of 2018, Dr. Buchholz became PI of the TPG. Dr. Buchholz is also the current Program Director for the OS/E program. The OS/E program is supported by faculty in Biomedical Engineering, Public Health, Mechanical Engineering and Nursing.

In the Fall 2018, the administration closed admissions to the MS option in Work Environment that had supported the Occupational Safety Ergonomics (OS/E) training program. The last students graduated with an MS in Work Environment in 2019. The OS/E program moved to a new home in the Francis College of Engineering (FCOE) with the advent of an Industrial Engineering program that is housed in the Mechanical Engineering Department. Trainees receive an MSE in Industrial Engineering awarded from FCOE.

The master’s OS/E program maintains the same fundamental courses that the MS in Work Environment did. As with the other WE programs, trainees are required to complete a three-course core: Work Environment Policy & Practice; Ergonomics & Work and Epidemiology & Biostatistics. OS/E trainees are also required to take courses in safety and ergonomics, including Occupational Safety Engineering and Occupational Biomechanics. In addition, all students are required to attend seminars on broad occupational health & safety topics and will need to complete an occupational health & safety masters project or doctoral thesis.

A semi-annual research symposium has been organized since 1998 by the UML and the University of Connecticut faculty and research staff. The occupational medicine program at UConn Health Science Center (Farmington) is a particularly valuable partner for Work Environment trainees. Students, staff and faculty from both universities who are working on occupational health and safety topics attend this day-long event held in Sturbridge, MA, halfway between the two campuses to present and discuss work in progress. Occupational psychology faculty and graduate students from the main UConn campus at Storrs also participate, broadening the scope of discussion even further. All NIOSH OS/E trainees are expected to attend at least one of these semi-annual Sturbridge research symposia during their graduate studies.

During the last five years, the OS/E program graduated four trainees who received an MS in Work Environment and one trainee who received an ScD in Work Environment. Since 1990, it has supported 24 trainees who received a MS and five who received a ScD degree.

Highlights: Occupational & Environmental Hygiene

Training for OEH-IH students prepares them for today's job market, where they typically take on multiple duties including safety, ergonomics, environmental compliance, and emergency response. Unique among occupational and environmental hygiene programs is the highly integrated nature of our curriculum that introduces students to all safety and health core areas. We take an integrated approach to worker health and safety as we strive to answer the basic question, "What is the optimum design of the healthy workplace?" It is our belief that specific problems, such as chemical exposures, biomechanical demands, and psychosocial stress are best addressed comprehensively rather than individually. For OEH-IH students the existence of the Toxic Use Reduction Institute (TURI) has provided the opportunity for unique training in the area of hazard control focused at the source rather than through retrofitting.

The OEH-IH program went through significant administrative and academic changes during the last five years. The Department of Work Environment, which had housed the TPG for its first 26 years, merged with another department to form the Department of Public Health prior to the Fall of 2016. In January of 2018, Drs. Bryan Buchholz and Laura Punnett both moved to the newly formed Department of Biomedical Engineering in the Francis College of Engineering (FCOE). In fall of 2018, Dr. Buchholz became PI of the TPG. In the Fall 2018, the administration closed admissions to the MS option in Work Environment that had supported the Occupational & Environmental Health (OEH-IH) training program. The last students graduated with an MS in Work Environment in May, 2019. The OEH-IH program was ABET-accredited through the graduation of the class of 2019 and supported primarily by faculty in Work Environment and Public Health.

As with the other WE programs, OEH-IH trainees were required to complete a three-course core: Work Environment Policy & Practice; Ergonomics & Work and Epidemiology & Biostatistics. OEH-IH trainees were also required to take a set of IH courses that include Evaluation of Work Environment Hazards and Solutions for Work Environment Hazards. In addition, all trainees were required to attend seminars on a broad range of occupational health & safety topics and completed an occupational health & safety masters project or doctoral thesis.

A semi-annual research symposium has been organized since 1998 by the UML and the University of Connecticut faculty and research staff. The occupational medicine program at UConn Health Science Center (Farmington) is a particularly valuable partner for Work Environment trainees. Students, staff and faculty from both universities who are working on occupational health and safety topics attend this day-long event held in Sturbridge, MA, halfway between the two campuses to present and discuss work in progress. Occupational psychology faculty and graduate students from the main UConn campus at Storrs also participate, broadening the scope of discussion even further. All NIOSH OEH-IH trainees were expected to attend at least one of these semi-annual Sturbridge research symposia.

During the last five years, the OEH-IH program graduated ten trainees who received an MS in Work Environment and one trainee who received an ScD in Work Environment. Since 1990, it has supported 43 trainees who received a MS and four who received an ScD.

Highlights: Work Environment Policy

WE Policy aims to create social and technological conditions that support worker and community safety, health and well-being within specific workplaces and/or broader systems of work as well as the ambient environment. WE Policy is applied at local, regional, national, and global levels and frequently aims to understand the links among them in relation to identifying health and safety problems and their solutions.

The WE Policy program at UML trained new professionals and researchers to enter the field of OSH for the first time and it also trained professionals from a variety of sectors who were already engaged in some aspect of OSH but had never acquired formal, academic training in OSH. Many professionals who engage in occupational and environmental safety and health policy do not have adequate training: economists and lawyers know little of the scientific and technological issues; health scientists have not been trained in social analytic methods and policy development. Many work environment experts have little understanding of the necessity and means of "risk communication" with the broad public; and few have an understanding of the social dimensions of the problems that they are seeking to address. The program in WE Policy was designed to bridge the quantitative and social disciplines that evaluate the workplace.

Another important aspect of the WE policy program was that it provides an opportunity for technically trained students to expand the arena in which they can operate. Industrial hygienists, ergonomists and safety professionals who have been practicing in their field sometimes want to have an impact beyond their particular employer or clients but they have limited knowledge of, for example, organizational management strategies or economics. Training in WE policy enabled them to extend their OSH reach. Equally important, technically-trained OSH practitioners are often thwarted in their attempts to introduce seemingly reasonable hazard control strategies into workplaces because they do not know how to operate successfully in the social and work organizational context surrounding their technical solution.

The WE Policy program went through significant administrative and academic changes during the last five years. In 2014, the master's program in Work Environment Policy transitioned from an option in the MS in Work Environment to a Global Environmental Sustainability and Health (GESH) option in an MPH. The GESH option closed shortly thereafter. The Department of Work Environment, which had housed the TPG for its first 26 years, merged with another department to form the Department of Public Health prior to the fall of 2016. In January of 2018, Drs. Bryan Buchholz and Laura Punnett moved to the newly formed Department of Biomedical Engineering in the Francis College of Engineering (FCOE). In fall of 2018, Dr. Buchholz became PI of the TPG. However, a new academic home for the WE Policy program could not be identified.

Trainees, in WE Policy as in other disciplines, were required to complete a three-course core: Work Environment Policy & Practice; Ergonomics & Work and Epidemiology & Biostatistics. In addition, all students were required to attend seminars on a broad range of occupational health & safety topics and completed an occupational health & safety masters project or doctoral thesis.

A semi-annual research symposium has been organized since 1998 by the UML and the University of Connecticut faculty and research staff working on occupational health and safety topics. WE Policy trainees - along with other students, staff and faculty from both universities - routinely attend this day-long event held in Sturbridge, MA, halfway between the two campuses,

to present and discuss work in progress. Occupational psychology faculty and graduate students from the main UConn campus at Storrs also participate, broadening the scope of discussion even further. All NIOSH Policy trainees were expected to attend at least one of these semi-annual Sturbridge research symposia.

During the last five years, the WE Policy program graduated one trainee who received an MS and two trainees who received an ScD. Since 1990, it has supported 17 trainees who received a master's and 16 who received an ScD.

V. Publications (trainees in bold)

Karlsson, ND, Markkanen PK, Kriebel D, Galligan CJ, Quinn MM. (2020) "That's not my job": A mixed methods study of challenging client behaviors, boundaries, and home care aide occupational safety and health. *Am J Ind Med.* 2020. Apr;63(4):368-378. doi: 10.1002/ajim.23082. PMID: [31833084](https://pubmed.ncbi.nlm.nih.gov/31833084/)

Kriebel D, Sama S, Bradbury M, Buchholz B, Curti S, Daines B, Deliso K, DeVries R, **Fleckner T**, Gore R, Mattioli S, Shah C, Wegman D. (2020) Risk factors for retinal detachment: A case control study, *Journal of Occupational and Environmental Medicine* 62(6): 445-451, doi: 10.1097/JOM.0000000000001867

Chin WS, Kurowski A, Chen G, Gore R, Nobrega S, Punnett L, SHIFT Research Team. (2019) Using a mobile app to conduct process evaluation in a participatory ergonomics healthcare intervention. International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS), Bologna IT, Sept 2-5, 2019. Abstracts available at http://www.premus2019.com/?page_id=43.

Karlsson ND, Markkanen PK, Kriebel D, Gore RJ, Galligan CJ, Sama SR, Quinn MM. (2019) Home care aides' experiences of verbal abuse: a survey of characteristics and risk factors. *Occup Env Med* 76(7): 448-454. DOI:10.1136/oemed-2018-105604. PMID: 31186370. Available open access.

Chin W, Kurowski A, Chen G, Gore R, Punnett L. (2018) Enhancing the usability of a mobile app for process evaluation in a participatory ergonomics healthcare intervention. (ABSTRACT) *Proceedings of the 20th Congress of the International Ergonomics Association*. DOI: 10.1007/978-3-319-96071-5_56.

Markkanen P, Quinn M, Goodyear N, Galligan C, Kriebel D, Sama S, Gore R, Lindberg J, Beato-Melendez C, **Karlsson N**, Mohamed H, Sheikh N, **Parker-Vega A**. (2018) 912 Cleaning and Disinfection in Home Healthcare: Integrating Qualitative and Quantitative Methods to Assess Caregivers' Exposure to Cleaning and Disinfection Products. (ABSTRACT) *International Commission for Occupational Health (ICOH) 2018 Conference, Apr 29 – May 4, Dublin, Ireland. Occup Environ Med, 75(Suppl 2), A348*. DOI:10.1136/oemed-2018-ICOHabstracts.996.

Plaku-Alakbarova B, Punnett L, Gore R, ProCare Research Team. (2018) Nursing home employee and resident satisfaction and resident care outcomes. *Safety and Health @ Work* 9(4):408-415. <https://doi.org/10.1016/j.shaw.2017.12.002>

Brouillette NM, Quinn MM, Kriebel D, Markkanen PK, Galligan CJ, Sama SR, Gore RJ, Laramie A, Davis L. (2017) Risk of sharps injuries among home care aides: Results of the Safe Home Care survey. *Am J Infect Control* 45(4):377-383. DOI: 10.1016/j.ajic.2016.11.018. PMID: 2806373. Available open access.

Brouillette NM, Quinn MM, Kriebel D. (2017) Risk of Sharps Injuries to Home Care Nurses and Aides: A Systematic Review and Meta-Analysis. *JOEM* 59(11):1072-1077. DOI:10.1097/JOM.0000000000001160. PMID: 28930800. Available open access.

DeVries R, Daines B, **Gosnell L**, Gore R, Sama S, Kriebel D. (2017) Exposure assessment for U.S. case-control study on occupational lifting and retinal detachment: A comparison of methods. (ABSTRACT) *Occup Environ Med* 74(Suppl 1):A101. DOI: 10.1136/oemed-2017-104636.267.

Dasgupta PS, Punnett L, Moir S, Kuhn S, Buchholz B. (2016) Does drywall installers' innovative idea reduce the ergonomic exposures of ceiling installation: A field case study. *Applied Ergonomics* 55:183-93. doi: 10.1016/j.apergo.2016.02.004.

Quinn M, Markkanen P, Galligan C, Sama S, Kriebel D, Gore R, **Brouillette N**, **Okyere D**, Sun C, Punnett L, Laramie A, Davis L. (2016) Occupational health of home care aides: results of the safe home care survey. *Occup Environ Med* 73:237-245. DOI: 10.1136/oemed-2015-103031. PMID: 26209318. Available open access.

Goodyear N, **Brouillette N**, **Tenaglia K**, Gore R, Marshall J. (2015) The effectiveness of three home products in cleaning and disinfection of *Staphylococcus aureus* and *Escherichia coli* on home environmental surfaces. *J Appl Microbiol* 119(5):1245-1252. DOI:10.1111/jam.12935. PMID: 26274937.