Final Progress Report

The University at Buffalo, SUNY Occupational Safety and Health Training Project

7/1/2010-6/30/2015

Grant #: 5 T01 OHOO8849

Submitted to:

Department of Health and Human Services
Centers for Disease Control and Prevention

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September 30, 2015

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List of Abbreviations

CSP:	**Certified Safety Professional**
EEH:	**Epidemiology and Environmental Health**
IE:	**Industrial Engineering**
ISE:	**Industrial and Systems Engineering**
MT	**Medical Technology**
NIOSH:	**National Institute for Occupational Safety and Health**
NY:	**New York**
NYC:	**New York City**
OSH:	**Occupational Safety and Health**
OSHA:	**Occupational Safety and Health Administration**
OT:	**Occupational Therapy**
RS:	**Rehabilitation Sciences**
SPM:	**Social and Preventive Medicine**
SUNY:	**State University of New York**
TRC:	**Toxicology Research Center**
UB:	**Universtity at Buffalo**
WMD:	**Work-related Musculoskeletal Disorder**
WNY:	**Western New York**

Abstract

Western New York (WNY) has large workforces in manufacturing, agricultural and service-related industries that have high rates of injuries and illness, but few opportunities exist for individuals who want to pursue graduate education in occupational safety and health (OSH) in this part of the country. The goal of the University at Buffalo, SUNY Occupational Safety and Health Training Project (UB OSH Training Project) is to produce highly qualified safety and health M.S. graduates to improve occupational safety and health (OSH) practice in WNY, and beyond.

The training project provided a unique multidisciplinary OSH training experience for MS students from 3 disciplines: Industrial & Systems Engineering, Occupational Therapy, and Epidemiology and Environmental Health. All students were required to take IE: 541 (Human Factors in Safety/Occupational Safety and Health), MT600 (Fundamentals of Industrial Hygiene) and SPM 501 (Introduction to Epidemiology) in addition to the required courses of their respective M.S. programs. Trainees were also provided with real-life OSH experiences and knowledge through existing university partnerships with manufacturing, service and health-related industries, and regular interactions with WNY OSH professionals. Interactions between trainees and local safety professionals allowed students to apply course materials to the workplace. The training program provided OSHA certificate training to give students practical safety information that can be quickly translated to the workplace, as well be used as an advantage when applying to positions that require backgrounds in OSH. Required research experiences allowed students to work independently and integrate knowledge from multiple courses to solve a significant OSH problem of personal interest.

The program was largely successful; producing graduates who have a unique inter-disciplinary graduate education that would otherwise not be offered at the University of Buffalo. In this past funding cycle, 12 trainees from three different disciplines, Industrial and Systems Engineering, Epidemiology and Occupational Therapy, participated in the program. Nine of the trainees took positions in OSH professions, including OSHA and NIOSH, with others having OSH related responsibilities as engineers and practitioners. Trainees also contributed to the scientific safety and health literature by completing a master's thesis and/or other related scientific publications.

Section 1: Findings and Impact

Significant (Key) Findings

The goal of the University at Buffalo, SUNY Occupational Safety and Health Training Project (UB OSH Training Project) is to produce highly qualified safety and health M.S. graduates to improve occupational safety and health (OSH) practice in WNY, and beyond. The program has been largely successful; producing graduates who have a unique inter-disciplinary graduate education that would otherwise not be available to students at the University of Buffalo, SUNY. In this past funding cycle, 12 trainees from three different disciplines, Industrial and Systems Engineering, Epidemiology and Occupational Therapy, participated in the program. Trainees completed coursework in occupational safety, epidemiology and industrial hygiene and other areas related to OSH, OSHA cerfiticate training in hazardous materials handling and record keeping, and gained real-life OSH experience and knowledge through existing university partnerships with manufacturing, service and health-related industries, and regular interactions with WNY OSH professionals. Many of the trainees took positions in OSH professions, including OSHA and NIOSH, with others having OSH related responsibilities as engineers, practitioners or researchers. Trainees also contributed to the scientific safety literature by completing a master's thesis and/or other related scientific publications.

Translation of Findings

The training project has had direct effects on industries and on the safety profession locally and beyond. Two of the trainees of this funding cycle work for OSHA as Compliance Officers; one works in Buffalo, the other works in Albany. Six other trainees have taken positions that have occupational safety responsibilities. One trainee is a Research Scientist for NIOSH in Pittsburgh, and is performing research devoted to improving safety in the mining industry.

Outcomes/Impact

Research completed by trainees has resulted in M.S. theses and scientific publications that contribute to the scientific knowledge-base of safety and health (see below). The project also provides an annual offering of MT 600 Fundamentals of Industrial Hygiene, a course that would otherwise not be available to UB graduate students. Trainees have participated in many OSH professional development activities, including project work and internships that have supported local OSH practice.

Publications

Fenzl, M. (2012). The effects of user-centered design on the usability of patient handling equipment. Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Fenzl, M., Paquet, V., and Ray, A. (2013). The effects of user-centered design on the usability of patient handling equipment. Proceedings of the IIE Annual Conference & Exposition, San Juan, Puerto Rico.

Frentzel, S. (2013). Effects of individual differences on fatigue during an assembly task. Master's research project, University at Buffalo, SUNY.

Gallagher, S., Pollard, J., Manke, N., & Heberger, J. (2011). Field assessment of biomechanical and physiological demands in sand and limestone bagging operations. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 55, 1002-1006.

Gallagher, S. & Heberger, J. (2013). Examining the interaction of force and repetition on musculoskeletal disorder risk: A systematic literature review. Human Factors, 55(1), 108-124.

Gustafson, W. & Cavuoto, L.A. (2015) Active workstations and their effect on performance and biomechanics. Presented at the *18th Annual Applied Ergonomics Conference*. Nashville, TN. March 16-19.

Gustafson (2015). Active workstations and their effect on performance and workload Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Heberger, J. (2013). A case-case comparison of ergonomic exposures associated with musculoskeletal injuries in maintenance workers of mineral processing mills and coal preparation plants, Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Heberger, J., Nasarwanji, M., Paquet, V., Pollard, J., & Dempsey, P. (2012). Inter-rater reliability of video-based ergonomic job analysis for maintenance work in mineral processing and coal preparation Plants. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 56(1), 2368-2372.

Houser, A., Bolton, M. (accepted). A Formal Approach to Modeling and Analyzing Human Task load in Simulated Air Traffic Scenarios, IEEE International Conference on Complex Systems Engineering.

Houser, A. (2014). Safety not guaranteed: Using formal methods in human factors engineering. International University Week.

Rodriguez, M. (2014), Social influences on young drivers' texting behavior while driving. Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Section 2: Scientific Report

Background

Educational Needs of the OSH Profession

A strong and broad educational background is extremely important fo effective OSH practice. The OSH practitioner is often tasked with a number of important responsibilities such as hazard recognition, inspection, fire protection regulatory compliance, hazardous materials management, environmental protection, training activities, accident recognition, and emergency response. Given the complexities of today's workplace driven by new technologies, automation, biotechnologies, and the increasing development and use of new chemicals, among other things, it is not surprising that safety professionals are required to be more highly trained and specialized than those of the past (ASSEF, 2007).

The educational backgrounds of OSH professionals are extremely varied, ranging from almost no formal coursework in OSH to the completion of graduate degrees in safety or related disciplines. Ninety percent of OSH professionals have a Bachelor's degree, with most from disciplines other than safety and health, and only 40% of the safety profession has an advanced degree, many in fields other than OSH (ASSEF, 2007).

The lack of formal education in occupational safety and health (OSH) offered by universities in this country combined with the rigorous technical requirements of the profession suggest that there is a great need for OSH educational programs that are comprehensive and place emphasis on modern real-life problem solving to prepare individuals to meet the diversity of challenges of their profession. For example, knowledge of work-related epidemiology, injury prevention and rehabilitation can all play an important role to reduce the economic burden of injuries on companies. There is also an important need for educational programs in OSH to encourage the enrollment of minorities and women into the profession. Women are vastly under-represented in this workforce, comprising only 15-20% of OSH practitioners (ASSEF, 2007).

Four allied OSH related areas that continue to be of increasing importance to the OSH profession are: 1) injury prevention through ergonomics, 2) knowledge of injury and illness prevention obtained through the epidemiological study of workplace exposures and health outcomes, 3) industrial hygiene related to the chemicals toxicology of chemicals used at work, and 4) and reducing the consequences of injury through occupational therapy.

Injury Prevention through Ergonomics. Work-related musculoskeletal disorders (WMDs) represent a significant problem in the United States. General risk factors at work that are cited include heavy manual materials handling, highly repetitive motions, sustained awkward postures and static muscular contractions, vibration,

temperature extremes and mechanical stresses. WMDs are preventable through the appropriate education and training of employers and employees, and through the use of the appropriate ergonomics engineering controls.

Epidemiological Study of Workplace Exposures and Health Outcomes**.** Epidemiologists play a fundamental role in preventive medicine and public health by providing an understanding of the determinants and distribution of diseases and the application of this information in the prevention of disease. Occupational epidemiology is the application of epidemiologic methods to the study of disease distributions among workers. Studies include investigations of how exposure to a variety of chemical, biological or physical agents at work impacts health risk among different groups of workers. Epidemiology requires disease surveillance, which is the systematic collection and interpretation of exposures and personal variables. Biostatistics is used in this discipline to evaluate the disease and exposure data in order to identify and quantify trends of illness across different industry types, occupations or estimated exposure levels. The information generated by the discipline provides important contributions to the understanding of how variables contribute to injury and illness risk.

Industrial Hygiene related to the Industrial Hygiene of Chemical Used at Work. While the acute and chronic effects of some toxic chemicals have been documented, the toxic effects of many chemicals remain unknown and the increasing use of new chemicals in many modern industries (e.g., computer manufacturing) have created a large demand for knowledge about how chemicals or combination of chemicals affect workers. Understanding the relationships between exposure, dose, and health effects of chemicals in various forms through different routes of entry is needed to effectively mitigate the effects of harmful substances that workers are exposed to at work. Education in industrial hygiene and toxicology provides important information that allows practitioners to better understand how to prevent illnesses that are related to chemical exposures.

Reducing the Consequences of Injury through Occupational Therapy. Once an individual leaves work due to injury, the ability of that person to return to work will depend on the physical capabilities of the person, the requirements of the job, the psychosocial characteristics of the work environment and effectiveness of the rehabilitation program. Additional factors also include the medical welfare system and economic state of the country. Return to work can be accelerated through a combination of improved physical rehabilitation, altering job demands to match the physical capacity of the injured individual and improvement of the psychosocial characteristics of the work environment.

Need for a NIOSH OSH Training Program in WNY

With nearly 20 million residents, New York (NY) remains the 3rd most populous state in the US (US Census Bureau, 2013). There are ~9 million non-farming workers in NY at ~600,000 workplaces (New York State Occupational Health Clinics

Oversight Committee, 2012). Over 200,000 workers in NY are injured each year (Bureau of Labor Statistics (BLS), 2014). Incidence rates of for non-fatal injuries are 3.2 per 100 full-time workers across all industries (BLS, 2014). Workers' compensation benefits in NY exceed $5 billion annually (National Academy of Social Insurance, 2013). Eighty-three percent of the occupational injuries and illnesses in NY occurred in service-providing industries, rather than goods producing, with the highest number of incidents in education and health services and trade, transportation, and utilities sectors (BLS, 2014). Industries with the highest rates of work-related injuries include public sector employees, including the police, and nursing home and health care workers (BLS, 2014).

In addition, due to the long history of heavy industry in New York, occupational illnesses such as asbestosis and other chronic occupational illnesses remain common (New York State Occupational Health Clinics Oversight Committee, 2012). The NY State Occupational Health Clinics also identified the reduction of occupational health disparities as an area of priority for the next five years (New York State Occupational Health Clinics Oversight Committee, 2012). New York has one of the more diverse populations (~15% black, and ~15% Hispanic (BLS, 2014)) and these groups experience different workplace safety challenges (Souza et al., 2010). New York has been progressive in deploying initiatives aimed at promoting worker safety. In particular, New York has enacted Safe Patient Handling legislation to reduce musculoskeletal injury risk in healthcare facilities. Local areas of emphasis for OSHA in the Buffalo Area include fall hazards in construction, warehousing and refuse handlers, machines, and nursing and residential care facilities.

OSH Education at the University at Buffalo

The University at Buffalo (UB), located in Erie County, is considered the flagship institution of the State University of New York (SUNY) system. The Departments of Industrial & Systems Engineering, Epidemiology and Environmental Health (formally Social and Preventive Medicine), and Rehabilitation Science (formerly Occupational Therapy) have been successful in producing graduates in OSH related fields.

For the past 8 years, the UB NIOSH OSH Training Program has been the only such program upstate New York. The closest NIOSH OSH Training Program is located in the Graduate School of Public Health at the University of Pittsburgh, over 200 miles from UB. The nearest NIOSH Education and Research Center, the New York/New Jersey Education and Research Center, is located at Mount Sinai in New York City (NYC), over 350 miles from UB. The UB program offers individuals within our region the opportunity to pursue a graduate degree that offers formal education and training concentrated in OSH without having to leave WNY.

Our NIOSH-sponsored training program has enabled us to offer a multi-disciplinary training experience to students who want to gain the required depth and breadth of knowledge across key OSH disciplines, including safety, ergonomics, industrial

hygiene, and epidemiology to be successful as OSH practitioners. We have had 26 trainee fellows (12 in the current cycle) who have participated in the UB NIOSH OSH Training Program, many of whom have become OSH practitioners. Trainees have participated in one of three graduate programs offered at UB:

Industrial & Systems Engineering. The Industrial & Systems Engineering Department at UB offers research-based M.S. and Ph.D. programs are available with concentrations in Human Factors/Ergonomics, Operations Research, and Production Systems Engineering. About 75 percent of the Department's Ph.D. graduates take positions in industry. Recent graduate degree holders have acquired positions with employers such as American Airlines, American Express, Avis, Boeing Aerospace, NASA-Langley, Sandia National Labs, and Eastman Kodak. Employers who have hired ISE graduates for OSH work include American Axle Manufacturing, GM Power Train, and Delphi Harrison Thermal Systems (the region's largest manufacturing employer). Much of the work produced by faculty and students of the Human Factors/Ergonomics program has focused on injury prevention.

Epidemiology and Environmental Health. The Department of Epidemiology and Environmental Health at the UB brings together faculty, graduate students, and postdoctoral fellows with widely diverse backgrounds, but whose research and scientific inquiry is in the area of Epidemiology. The Department's research focus is in the areas of epidemiology, disease prevention and community health. The faculty has research interests that include epidemiology of cancer, cardiovascular diseases, diabetes, osteoporosis and chronic diseases of aging, as well as research in the areas of women's health, disease prevention, molecular epidemiology and environmental and occupational epidemiology. Included in this work is evaluation of factors such as nutrition, physical activity, stress, genetic factors, and hormones in relation to risk of chronic diseases.

The Department offers both a M.S. and Ph.D. in epidemiology. The Master of Public Health program prepares students for public health careers by providing a comprehensive understanding of public health philosophy, as well as the practical knowledge and skills needed to address current and emerging public health issues. The MPH program is for health professionals with or without doctoral degrees and for individuals who through undergraduate study and/or experience have substantial interest in a career in public health.

Rehabilitation Science. The Department of Rehabilitation Science offers accredited professional programs in Occupational Therapy and Physical Therapy that lead to eligibility to take national certification examinations required for professional licensure, a Ph.D. program in RS, and an advanced certificate program in Assistive and Rehabilitation technology.

Three of the 10 most rapidly growing employment opportunities for OTs are related to occupational safety and health of the workforce: (a) occupational ergonomics consulting, (b) design and accessibility consulting for persons with disabilities, and

(c) technology and assistive device development for people whose disabilities affect mobility, computer usage, and environmental control. The Department's Occupational Therapy (OT) Program is consistently ranked in the top 10 of the 80 accredited program in the U.S. based on the philosophical belief that people have a vital need for occupation.

A History of Collaborative Research and Teaching Activities

A large degree of inter-departmental collaboration exists among faculty in these and other departments to support the program. For example, Dr. Paquet (PI, Industrial Engineering) and Dr. Lenker (Co-PI, Rehabilitation Science) frequently guest lecture in each other's courses, and Paquet holds an adjunct appointment in the Department of Rehabilitation Science. Paquet and Lenker have worked together on sponsored research activities and have co-authored several peer-reviewed publications together. Research activities have included projects for the Rehabilitation Engineering Research Center on Universal Design at Buffalo, a program designed to ensure the effective and safe design of environments for all, with a particular emphasis on considering the needs of older individuals and those with disabilities. Paquet has also collaborated with faculty of the Epidemiology and Environmental Health Department on NIOSH sponsored research activities and has served as a guest lecturer for this department.

Specific Objectives

The overall objective of this occupational safety and health (OSH) training program was to strengthen the expertise and increase the pool of qualified OSH professionals in Western New York (WNY) and nearby regions in order to more adequately protect their workforces. Graduates of the program were uniquely prepared to become safety engineers in manufacturing or healthcare facilities, or take government OSH positions.

The Program

The program provided trainees with formal OSH training while obtaining a master's degree from one of three allied health professions: human factors/ergonomics, epidemiology, and occupational therapy. Trainees were recruited from the Department of Industrial & Systems Engineering, Department of Epidemiology and Environmental Health, and Department of Rehabilitation Science at UB, SUNY. A unique feature of the training program was that it was designed to encourage interdisciplinary learning experiences in and out of the classroom.

A variety of teaching methods designed to enhance student learning, class participation and student retention were used. For example, trainees were provided with real-life OSH experience and knowledge through existing university partnerships with manufacturing, service and health-related industries, and regular planned interactions with WNY OSH professionals. Research methods were

emphasized in the required coursework of each department and students gained experience in applying research methods to M.S. thesis work or a capstone field experience.

Common Graduate Courses

Three core graduate OSH core courses were required of all trainees: IE 541: Occupational Safety and Health, SPM 501: Introduction to Epidemiology, MT 600: Fundamentals of Industrial Hygiene. MT 600 is a graduate course supported by this project that would otherwise not be taught at UB. It offers trainees and others students at UB the opportunity to learn about fundamental industrial hygiene principles such as the identification, evaluation and control of chemical, biological and physical hazards in the workplace. A board certified industrial hygienist taught the course annually. Environmental monitoring techniques, worker exposure measurement and application of control measures were covered. The course had lecture, laboratory and field-based work components that were a mixture of didactic presentations, class discussions, student presentations, guest lecturers, industrial site visits, class exercises, and the opportunity to work with various types of industrial hygiene and personal protective equipment. Additional elective coursework in each of the participating departments covered other important OSH topics such as occupational ergonomics, biomechanics, and human information processing. These are described further in "Departmental Course Requirements" below.

OSHA Certificate Training

Trainees completed two OSHA certificate courses provided by UB's Toxicology Research Center:

OSHA 511: Occupational Safety and Health Standards for General Industry. This was a 4-day certificate course for private sector personnel focusing on OSHA standards for general industry. Key general industry subparts are discussed in detail.

OSHA 7500/7505/7845: Introduction to Safety and Health Management, Accident Investigation, and Record Keeping. This was a two-day OSHA certificate course designed to provide professionals with the tools necessary to effectively manage OSH within an organization.

These courses provided students with practical experiences with safety equipment in a controlled environment, and presented information on regulations and covered best current OSH practices.

Local Meetings with OSH Professionals

Trainees participated in local meetings of the Niagara Frontier Chapter of the American Society of Safety Engineers (ASSE) and quarterly meetings of the Western New York Federal Safety and Health Council. These meetings provide a unique opportunity to network with industry and government representatives from Western New York. Table 1 provides examples of the ASSE meeting topics.

Conferencse

Each spring, trainees attended the Western New York Safety Conference. This event, hosted since 1936, is an annual exchange of safety, health, and enviromental information directed toward the first line supervisors, workers, company administrators with safety and health responsibilities, and the practicing professional. In spring 2015, one trainee presented a paper, "Active workstations and their effect on performance and biomechanics" at the national Applied Ergonomics Conference.

Table 1. Trainees attended Niagara Frontier Chapter ASSE Meetings.

Meeting Title	Date
Facility tour of Praxair	January 6, 2011
New residential construction fall protection directive	January 20, 2011
Silent Danger: 5 crucial conversations that drive workplace safety	April 11, 2011
OSHA update	September 19, 2011
Training for the new workforce	October 17, 2011
Global harmoniztion system	November 18, 2011
Facility tour of Dunlop Tire Corporation	January 17, 2012
Gas detection 101: Training and Q&A session	February 23, 2012
Mind over matter	April 17, 2012
Case Studies 2012	June 22, 2012
Annual OSHA update	September 17, 2012
Working safely goes against human nautre	October 15, 2012
Distracted driving	November 9, 2012
Facility tour of Whiting Door and Perry's Ice Cream	January 14, 2013
Dig safely	February 14, 2013
Case Studies 2013	April 19, 2013
OSHA's fall prevention in construction and heat illness prevention campaign	May 17, 2013
OSHA update 2013	September 13, 2013
Facility tour of Covanta Energy	January 13, 2014
NFPA 70E update	February 27, 2014
How to handle medical emergencies in the workplace	April 24, 2014

ISE Seminars

The UB ISE Department offers a regular seminar series for graduate students. At the beginning of each year, the program's faculty selects seminars offered by the departments that are thought to be particularly relevant for trainees. At least one speaker in the area of OSH is invited each semester (See Table 2). The Jack Bisantz Memorial Lecture is a special seminar hosted by ISE to honor Jack Bisantz, who worked as a safety consultant and was a Buffalo firefighter. He worked in the area of occupational fire prevention among other safety arenas. He also guest lectured for approximately 10 years for IE 541: Human Factors in Safety/Occupational Safety. This seminar is sponsored through the support of a department alumna. Trainees attended these seminars and met with the speakers. Feedback from trainees suggests that the seminars and interactions with outside researchers are quite useful and, in some cases, have helped students select M.S. research projects.

Table 2. Example lectures of the ISE Department Seminar Series

Speaker	Seminar Title	Date
Patrick Dempsey, NIOSH	Ergonomics Approaches to Solving Safety and Health Problems in Mining	April 15, 2011
Ayse Gurses, Johns Hopkins University	Identifying and Categorizing Patient Safety Hazards in the Cardiac Operating Room	October 13, 2011
Ranjana Mehta, Texas A&M University	Neural Correlates of Physical and Mental Fatigue	November 9, 2012
Rammohan Maikala, Liberty Mutual Research Institute for Safety	Evaluating Human Performance using Non-invasive Optical Spectroscopy	November 30, 2012
Alex Kirlik, University of Illinois, Urbana-Champaign	Making Better Predictions: Especially of the Future	March 28, 2013
Birsen Donmez, University of Toronto	Supporting the Human Operators of Transportation Systems	November 22, 2013
Karim Abdel-Malek, University of Iowa	Santos: The Virtual Soldier	April 18, 2014

Departmental Course Requirements

The additional degree requirements placed on trainees from different departments had both common and unique features. Common requirements of all departments include coursework in statistics. Another common feature of the departmental course requirements is that all place a great emphasis on research. Trainees of each department receive education in the responsible conduct of research and how to write research proposals, and take courses that cover research design and statistical methods. Additionally, all trainees completed the NIH training on the ethical treatment of human subjects, wrote research proposals, and carried out laboratory and/or field work. Differences in the technical content of courses across

departments ensured that the trainees received the educational depth needed to be able to specialize in an OSH sub-discipline supported by their departments. Typical academic courses of study for trainees of each department are given in Tables 3-5.

The training program was evaluated by monitoring of student course evaluations, student grades, feedback from manufacturing or health-related industrial partners, surveys of trainees, and an annual tracking of trainee careers. An Advisory Committee provided feedback about the project structure and progress. This information was used to make changes to project in the next funding cycle.

Table 3. Example M.S. program in Industrial Engineering (Ergonomics) with a concentration in OSH.

Course	Title	Credits
Fall		
SPM 501*	**Epidemiology**	4
IE 507	Design and Analysis of Experiments (& Statistics)	3
IE 531	Human Factors Research Methodology	3
Spring		
MT 600	**Fundamentals of Industrial Hygiene**	4
IE 541*	**Occupational Safety and Health**	3
OSH Elective (e.g, OT 534)	Ergonomics and Job Accommodation	3
Fall		
OSH Elective (e.g, IE 536)	Work Physiology	3
OSH Elective (e.g, IE 636)	Applied Occupational Musculoskeletal Epidemiology	3
IE 559	OSH Thesis or Field Project	3
Spring		
IE 560	OSH Thesis or Field Project	3

Table 4. Example M.S. program of study in Occupational Therapy with a Concentration in OSH.

Course	Title	Credits
Fall		
IE 541	**Occupational Safety and Health**	3
SPM 501	**Epidemiology Principles**	4
OT 504	Advanced Management for Occupational Therapists	3
OT 506	Research Skills	3
OT 563	Project Seminar I	3
OTD 551	Occupational Behavior Theory	3
Spring		
MT 600	**Fundamentals of Industrial Hygiene**	4
OT 534	Ergonomics and Job Accommodation	3
OT 509	Community-Based Practice	3
OT 564	Project Seminar II	3
OT 505	Applied Geriatrics	3

Table 5. Example M.S. program in Epidemiology with a concentration in OSH.

Course	Title	Credits
Fall		
SPM 501	**Epidemiology Principles**	4
STA 527	Introduction to Medical Statistics	3
SPM 533	Principles of Public Health	3
SPM 590	Graduate Seminar	0
Spring		
STA 506	Introduction to Statistical Computing	3
SPM 549	Environmental Health	3
SPM 502	Advanced Methodology	3
SPM 506	Application of Statistics to Epidemiology	3
SPM 590	Graduate Seminar	0
Fall		
IE 541*	**Occupational Safety and Health**	3
SPM 507	Introduction to Health Care Organization	3
SPM Elective (e.g., IE 636)	Applied Musculoskeletal Epidemiology	3
SPM 590	Graduate Seminar	0
Spring		
MT 600	**Fundamentals of Industrial Hygiene**	4
SPM 527	Study of Health Behaviors	3
Elective (e.g., SPM 549)	Environmental Health	3
OSH Elective (e.g., OT 534)	Ergonomics and Job Accommodation	3
SPM 630	Integrative Project in OSH	2

Project Administration

The administrative structure of the training project is shown in Figure 1. Each participating department had at least one Program Coordinator who recruited trainees and ensured that trainees met the academic requirements of the OSH program and the degree. The original Program Coordinators were Victor Paquet, Sc.D., Associate Professor of Industrial & Systems Engineering, Joan Dorn, Ph.D., Professor Emeritus of Social and Preventive Medicine and Professor and Chair of Exercise Science, Paul Kostyniak, Ph.D., Professor of Pharmacology and Toxicology and Director of the Toxicology Research Center, and James Lenker, Associated Professor of Rehabilitation Science. Dr. Dorn left UB in year 1 of the funding cycle. She was replaced by Dr. Matthew Bonner, Associate Professor of Epidemiology and Environmental Health (formerly Social and Preventive Medicine). Dr. Lora Cavuoto, Assistant Professor of Industrial and Systems Engineering, joined the faculty team in year 4 of the funding cycle and served as Project Co-Director (with Paquet) in year 5. Dr. Joseph Syracuse provided the OSHA Enrichment Training and assisted with the MT 600. A 3-person Training Program Advisory Committee provided feedback about improving the program. Administrative support was provided by the Industrial and Systems Engineering Department in kind.

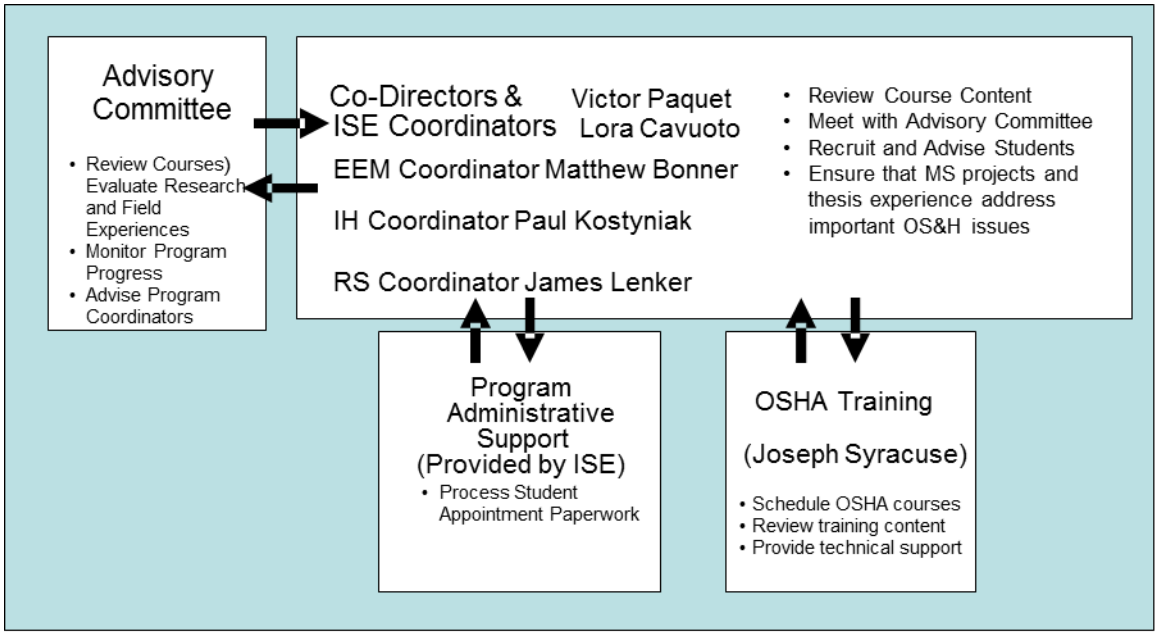

Figure 1. Schematic of the project's administrative structure.

Program Co-Directors

Victor Paquet, Sc.D. is Associate Professor of Industrial and Systems Engineering. He has a Sc.D. in Work Environment from the University of Massachusetts Lowell and an M.S. in ISE from Virginia Tech. For eight years, he has served as the Director or Co-Director of UB's Occupational Safety and Health Training Grant Project. He is also the Director of UB's Center for Excellent on Home Health in Well Being through Adaptive Smart Environments. His research activities focus primarily in two areas: 1) work-related over-exertion injury and illness prevention, and 2) design practices and accommodations (including job accommodations) for those with physical disabilities. These include topics such as ergonomics intervention studies for improved work environment, engineering anthropometry and digital human modeling for improved engineering design, inclusive design (i.e., "design for all"), and assistive technologies for those with disabilities. These activities have been funded by U.S. government sponsors such as the National Institute for Occupational Safety and Health (NIOSH), National Institute for Disability and Rehabilitation Research (NIDRR), and private industry. He has authored or co-authored over 90 peer-reviewed journal articles and conference publications. He is Scientific Editor of Applied Ergonomics, and serves on the editorial board of two other scientific journals. He is a reviewer for over a half dozen scientific journals, and regularly reviews proposals for the U.S. National Institutes of Health and National Institute for Occupational Safety and Health. He has advised as major professor 8 Ph.D. graduates and close to 20 M.S. graduates. He teaches graduate and undergraduate

courses in occupational safety, physical ergonomics, occupational biomechanics, human factors, and job analysis methods.

Lora Cavuoto, Ph.D. is Assistant Professor of Industrial and Systems Engineering, and served as Project Co-Director in the fifth year of the funding cycle. She has a Ph.D. in Industrial and Systems Engineering from Virginia Tech and an M.S. in Occupational Ergonomics and Safety from the University of Miami. Dr. Cavuoto was a NIOSH-funded trainee from 2007-2008 while pursuing her Master's degree at the University of Miami and in 2009 while pursuing her Ph.D. at Virginia Tech. The main objective of her research program is to understand and model the effects of individual differences on physical capacity through the assessment of injury risk, the development of inclusive work environments, and the design of wellness promotion interventions. Overall, her research aims to promote a healthier and more productive individual and work environment. She is currently the main research advisor for 2 Ph.D. and 2 M.S. thesis students and serves on 3 Ph.D. dissertation committees. In addition, over the past two years, 6 undergraduate and 3 M.S. students have completed supervised research projects in her Ergonomics and Biomechanics Lab.

Training Program Component Coordinators / Other Key Personnel

Paul Kostyniak, Ph.D., D.A.B.T. is a Professor of Pharmacology and Toxicology and the founding Director of the TRC in the School of Medicine and Biomedical Sciences at UB. Dr. Kostyniak holds a B.S. in Biology from St. John Fisher College and a Ph.D. in Toxicology from the University at Rochester. He is Board Certified in General Toxicology by the American Board of Toxicology. His research has focused on exposure assessment to persistent environmental chemicals of concern including PCBs, PBDEs, pesticides, and heavy metals. He has authored over 75 scientific publications and book chapters. He has developed and coordinated numerous Environmental Toxicology and Occupational Health courses for graduate and medical students. For the last 25 years he has overseen the Hazardous Materials Training division of the Center, which houses an OSHA Training Center and develops course manuals as well as hazard specific education modules used in that Center and in various Hazardous Materials Training Grants. Dr. Kostyniak has been a co-Investigator with Dr. Paquet since the inception of the NIOSH Training Project at the UB. Dr. Kostyniak is also a founding board member of the recently funded New York State Center for Occupational and Environmental Medicine (COEM), which is housed at the Erie County Medical Center. He coordinated offerings of the Industrial Hygiene course at the TRC and advised Dr. Syracuse about OSHA Training offerings.

Joseph Syracuse, Ph.D. is the Director of the Atlantic OSHA Training Center (AOTC) and the Hazardous Materials Education Program for the TRC of UB. He is responsible for the administration, curriculum design, development, content and quality, and instructor assignments for all courses conducted by the TRC. In addition, Dr. Syracuse serves as an instructor in many courses and in this capacity he has instructor certifications for US EPA and NYS DOH for asbestos abatement,

OSHA Trainer for Construction and General Industry, and others. He holds a B.A. in Biology from Canisius College and an M.A. and Ph.D. in Biology from UB. Dr. Syracuse has over 30 years of experience in education and curriculum design at all levels. He has provided training to workers and other professionals in environmental and occupational safety and health. In addition, he has instructional experience at the primary and secondary school levels, as well as college, graduate and postgraduate levels. He has designed curricula for occupational safety and health training that includes HAZWOPER, asbestos and lead abatement, indoor air quality, blood borne pathogens, among others. He has developed the curriculum in use by a local hospital to provide the OSH rotational training for medical residents. For this training program, Dr. Syracuse provided OSHA training courses taken by the trainees and helped foster extracurricular practical experiences for the trainees.

Hartley Hutchins, M.S., C.I.H., C.S.P. is an instructor of the UB TRC. He holds a B.S. in Biological Science and Chemistry from the University of Illinois and a M.S. in Biological and Environmental Sciences from Illinois State University. Mr. Hutchins is certified by the American Board of Industrial Hygiene and the Board of Certified Safety Professionals in the comprehensive practice of industrial hygiene and safety. He is also a Diplomat of the American Academy of Industrial Hygiene. He has over 30 years of experience in the public and private sector, and over 25 years in process engineering and environmental health and safety activities. He has been instructor for the Fundamentals of Industrial Hygiene course since the inception of the NIOSH training program.

Joan Dorn, Ph.D. is Professor Emeritus of Social and Preventive Medicine. Dr. Dorn received a BS in Physical Education at Ithaca College, MS in Physical Education/Exercise Physiology at the State University College of NY at Cortland, and PhD in Epidemiology and Community Health at the University at Buffalo, SUNY. Her research interests focus on cardiovascular disease epidemiology (CVD), particularly the role of physical activity in heart disease prevention. She also directed the Western New York Wellness Works, a $1 million state funded program designed specifically to improve the health and wellness of workers in Western New York. She left UB in the 2nd year of the project and was replaced by Dr. Bonner.

Matthew Bonner, Ph.D. is Associate Professor of Epidemiology and Environmental Health. He joined the Department of Epidemiology and Environmental Health in 2005. Previously, he was a Postdoctoral Fellow in the Occupational and Environmental Epidemiology Branch, Division of Cancer Epidemiology and Genetics at the National Cancer Institute, National Institutes of Health, Department of Health and Human Services. His research interests include environmental and occupational epidemiology, cancer epidemiology, pesticides, air pollution, radon, polycyclic aromatic hydrocarbons, phthalates. He replaced Dr. Dorn in year 2 of the grant cycle and advised 1 of the project's trainees.

James Lenker, PhD, OTR/L, ATP is Associate Professor of Rehabilitation Science. Dr. Lenker is a licensed occupational therapist and certified assistive technology

practitioner with 20 years of experience in the AT field. His doctoral degree is human factors engineering. He is noted for his expertise in AT outcomes measurement, which includes ongoing participation on two Department of Education NIDRR-funded DRRPs that focus on AT outcomes research. Dr. Lenker recruited and oversaw the progress of 4 trainees who pursed master's degrees in Occupational Therapy.

Results

Trainees

In this past funding cycle, 12 trainees from three different disciplines, Industrial and Systems Engineering, Epidemiology and Occupational Therapy, participated in the program. These included 7 from Industrial and Systems Engineering, 4 from Rehabilitation Sciences, and 1 from Epidemiology and Environmental Health. Research methods and applications of theory to practice were emphasized in the required coursework. Trainees were provided with real-life OSH experiences and knowledge through existing university partnerships with manufacturing, service and health-related industries, and regular planned interactions with WNY OSH professionals. Upon graduation, 9 trainees took positions in OSH professions, including OSHA and NIOSH, with others having OSH related responsibilities as engineers and practitioners. The employment outcomes for each trainee are summarized in Table 6.

Brief descriptions of each trainee's research activities are provided below. Advisors are listed in parentheses.

John Heberger (Bonner/Paquet). John Heberger entered the Epidemiology and Environmental Health (formally Social and Preventive Medicine) M.S. program in fall 2008. In 2010, his advisor (Dr. Dorn) left UB for a position with the Center of Disease Control and Prevention. Dr. Matthew Bonner was brought on as the SPM Co-I for the grant. Mr. Heberger took a position with NIOSH in Pittsburgh in 2010 as a Behavioral/Research Scientist and completed several publications that were related to his training experience, including his Master's thesis (Advised by Dr. Bonner, with assistance from Dr. Paquet). Mr. Heberger was a student until 2013 while working for NIOSH.

Mark Fenzl (Paquet/Ray). Mark Fenzl entered the Industrial and Systems M.S. program in Industrial Engineering (Human Factors Concentration) in fall 2010. His research focused on evaluating the usability of safe-patient handling devices, and he performed a laboratory study to systematically identify lift and sling design characteristics that affected task difficulty. Dr. Paquet and Dr. Ray, Assistant Professor of Rehabilitation Science and Director of UB's Safe Patient Handling Laboratory, co-advised Mr. Fenzl on his thesis.

Table 6. Employment outcomes for the UB OSH Training Project for trainees who participated during the 2010-2015 project period.

Trainee by Year Entered Program	Date Entered Program (mm/yy)	Date Degree Awarded (mm/yy)	Degree Awarded	Employment (Job Title/Employer	OSH Field
Year 1					
John Heberger	08/08	06/13	M.S.	Epidemiologist / NIOSH	Y
Mark Fenzl	08/10	09/12	M.S.	Compliance Officer / OSHA	Y
Scott Frentzel	08/10	02/13	M.S.	Industrial Engineer / Protective Industries	Y
Shaina Garner	08/10	06/11	M.S.	Occupational Therapist / Ageless Living Home Health /	N
Matthew Shea	08/10	06/11	M.S.	Occupational Therapist / Private Medical Practice /	N
Year 2					
Nicole Habermehl	08/11	06/12	M.S.	Occupational Therapist / Genesis Rehabilitation Services	N
Year 3					
Maria Rodriguez	08/12	06/14	M.S.	Compliance Officer / OSHA	Y
Kevin King	08/12	06/13	M.S.	Occupational Therapist / Buffalo Ergonomics /	Y
Year 4					
Woodrow Gustafson	08/13	6/14	M.S.	Ergonomist / Self Employed	Y
Adam Houser	08/13	6/14	M.S.	Ph.D. Student Researcher/ UB	Y
Year 5					
Lydia Kocher	08/14	n/a		Research Assistant/ UB	Y
Trevor Plizga	08/14	n/a		Ergonomics Intern / UB	Y

Scott Frentzel (Paquet). Scott Frentzel entered the Industrial and Systems M.S. program in Industrial Engineering (Human Factors Concentration) in fall 2010. After finishing his coursework, Mr. Frentzel took a position at a local manufacturing company, Protective Industries. While working at the company, he completed an applied research project that evaluated individual differences in muscular fatigue response during extruding work.

Shaina Garner (Lenker/Hutchins). Shaina Garner entered the Rehabilitation Sciences M.S. program in Occupational Therapy in fall 2010. Ms. Garner performed an applied research project with a local manufacturer of insulation materials.

Matthew Shea (Lenker/Hutchins). Matthew Shea entered the Rehabilitation Sciences M.S. program in Occupational Therapy in fall 2010. Mr. Shea performed an applied research project at a local railcar maintenance facility.

Nicole Habermehl (Lenker/Hutchins). Nicole Habermehl entered the Rehabilitation Sciences M.S. program in Occupational Therapy in fall 2011. Ms. Habermehl performed an applied research project at a tire manufacturer.

Maria Rodriguez (Paquet). Maria Rodriguez entered the Industrial and Systems M.S. program in Industrial Engineering (Human Factors Concentration) in fall 2012. She was interested in the social contributors to "deviant" driving behaviors such as texting, and performed a survey of close to 400 young drivers to identify variables that were associated with texting and driving.

Kevin King (Lenker). Kevin King entered the Rehabilitation Sciences M.S. program in Occupational Therapy in fall 2012. Mr. King performed an applied research project at an ergonomics consulting company.

Woodrow Gustafson (Cavuoto). Woodrow Gustafson entered the Industrial and Systems M.S. program in Industrial Engineering (Human Factors Concentration) in fall 2013. His thesis characterized the health benefits of "treadmill workstations" during office work.

Adam Houser (Bolton). Adam Houser entered the Industrial and Systems M.S. program in Industrial Engineering (Human Factors Concentration) in fall 2013. He is currently working with Dr. Bolton (Assistant Professor of Industrial Engineering) on research that quantitatively models safety-critical events in complex systems.

Lydian Kocher (Cavuoto). Lydia Kocher entered the Industrial and Systems Engineering's M.S. program in fall 2014 and and is currently in year 2 of her program. She is working on a thesis related to fall risk among the aging.

Trevor Plizga (Paquet). Trevor Plizga entered the Industrial and Systems Engineering's M.S. program in fall 2014 and and is currently in year 2 of his

program. He is working on a thesis related to psychosocial factors that affect injuries in the automotive industry.

Training Program Effects on Research Direction

The training program has had an important impact in the direction of research among participating UB faculty. Dr. Paquet continues to collaborate with scientists from NIOSH Pittsburgh (Drs. Dempsey and Nasarwanji), in part, due to the work performed by past trainee, Mr. Heberger. Dr. Paquet and Dr. Ray have continued to pursue safe-patient handling work as a result of Mr. Fenzl's thesis work, and will soon team up with Kaleida Health on a research project design to help inform NY state's future safe patient handling requirements. This NIOSH Training Program has allowed Dr. Cavuoto to pursue a new line of occupational cardiovascular health research. Related publications are listed below.

Publications

Scientific publications associated with research completed as a result of the training program are given below.

Fenzl, M. (2012). The effects of user-centered design on the usability of patient handling equipment. Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Fenzl, M., Paquet, V., and Ray, A. (2013). The effects of user-centered design on the usability of patient handling equipment. Proceedings of the IIE Annual Conference & Exposition, San Juan, Puerto Rico.

Frentzel, S. (2013). Effects of individual differences on fatigue during an assembly task. Master's research project, University at Buffalo, SUNY.

Gustafson, W. & Cavuoto, L.A. (2015) Active workstations and their effect on performance and biomechanics. Presented at the *18th Annual Applied Ergonomics Conference*. Nashville, TN. March 16-19.

Gustafson, W. (2015). Active workstations and their effect on performance and workload. Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Gallagher, S., Pollard, J., Manke, N., & Heberger, J. (2011). Field assessment of biomechanical and physiological demands in sand and limestone bagging operations. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 55, 1002-1006.

Gallagher, S. & Heberger, J. (2013). Examining the interaction of force and repetition on musculoskeletal disorder risk: A systematic literature review. Human Factors, 55(1), 108-124.

Heberger, J. (2013). A case-case comparison of ergonomic exposures associated with musculoskeletal injuries in maintenance workers of mineral processing mills and coal preparation plants, Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Heberger, J., Nasarwanji, M., Paquet, V., Pollard, J., & Dempsey, P. (2012). Inter-rater reliability of video-based ergonomic job analysis for maintenance work in mineral processing and coal preparation Plants. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 56(1), 2368-2372.

Houser, A., Bolton, M. (accepted). A Formal Approach to Modeling and Analyzing Human Task load in Simulated Air Traffic Scenarios, IEEE International Conference on Complex Systems Engineering.

Houser, A. (2014). Safety not guaranteed: Using formal methods in human factors engineering. International University Week.

Rodriguez, M. (2014), Social influences on young drivers' texting behavior while driving. Master's thesis, University at Buffalo, SUNY. ProQuest/UMI.

Enrollment Statistics

The enrollment statistics based for ethnic categories as required by NIOSH are provided in Table 7. One third of the trainees were women. One of the female trainees was of Hispanic descent.

Table 7. Inclusion Enrollment Table

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown			
	Female	Male	Unknown	Female	Male	Unknown	Female	Male	Unknown	
American Indian/Alaska Native	0	0	0	0	0	0	0	0	0	0
Asian	0	0	0	0	0	0	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	0	0	0	0	0
Black or African American	0	0	0	0	0	0	0	0	0	0
White	3	8	0	1	0	0	0	0	0	12
More than One Race	0	0	0	0	0	0	0	0	0	0
Unknown or Not Reported	0	0	0	0	0	0	0	0	0	0
Total	3	8	0	1	0	0	0	0	0	12

Materials available for other Investigators

N/A

Conclusions

Key accomplishments of the UB OSH Training Project include: 1) participation of 12 graduate trainees, 2) placement of 2 trainees in OSHA, 1 in NIOSH, with others actively pursuing OSH related responsibilities, 3) support of research activities in OSH that would otherwise not have been pursued, 4) the offering of MT 600: Fundamentals of Industrial Hygiene that would otherwise not be taught at UB, 5) M.S. thesis and conference publications, and 6) continued ties with local safety and health professionals that recently have led to a UB OSH internship program.

During the current project period, the training program faculty and trainees were split across three academic departments: Industrial and Systems Engineering (ISE), Rehabilitation Sciences, and Social and Preventive Medicine. While this provided a unique multi-disciplinary training experience for the students by having them exposed to different OSH perspectives, the program was at times hindered by difficulties recruiting and retaining trainees from the different departments, and coordinating training activities across departments. Of the students who have completed the training program, those from Industrial and Systems Engineering were best able to take advantage of the program's activities and were most likely to enter OSH careers upon graduation. Significant changes to this program are planned for the next funding cycle. Overall, however, the program was successful in its contributions to the safety and health profession in WNY and beyond.

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