Final Progress Report

University of North Carolina
Chapel Hill, NC 27599-7469

Occupational Safety and Health Education and Research Center

Bonnie Rogers, DrPH, COHN-S, LNCC, FAAN
Principal Investigator/Program Director

NIOSH Grant # 2 T42/OH 008673
7/1/07 – 6/30/12

Table of Contents

ABSTRACT

The purpose of the North Carolina Occupational Safety and Health Education and Research Center (NC OSHERC) is to train practitioners and researchers in the disciplines of Occupational Exposure Science/ Industrial Hygiene (OES), Occupational Health Nursing (OHN), Occupational Safety/Ergonomics (OS/E), Occupational Medicine (OM), and Occupational Epidemiology (OE).

The NC OSHERC is administered by an Executive Committee consisting of Center Director (Bonnie Rogers, DrPH, COHN-S, LNCC, FAAN) who also serves as the Program Director for Occupational Health Nursing; Leena Nylander-French, PhD, Industrial Hygiene Program Director; Dana Loomis, PhD, Occupational Epidemiology Program Director; Gary Mirka, PhD, Safety/Ergonomics Program Director; and Kathleen Buckheit, MPH, Director of Outreach/Continuing Education and the Hazardous Substance Training Program. All programs are located at the University of North Carolina, Chapel Hill, with Occupational Medicine at Duke University and Safety/Ergonomics at North Carolina State University in Raleigh, NC.

The NC OSHERC utilizes advisory boards for the overall Center and independently for several of the programs listed above. These committees consist of members from industry, government, and academia, and they provide input regarding curricula; needs assessment; and regional, national, and global perspectives on occupational health and safety. Each program area has a representative to the Center Advisory Board (see attachment). The Center Advisory Board has an additional labor/community and government representative and meets with the ERC Executive Committee to coordinate the advisory process, propose actionable items, and facilitate changes within the ERC.

During the period from July 1, 2007 to June 30, 2012 the UNC ERC graduated a total of 43 NIOSH funded students in the core disciplines, and offered 690 continuing education courses to 22,102 professionals. The ERC remains committed to its mission of providing high quality education for the occupational and safety field.

CENTER WIDE ADMINISTRATION

The period covered by this report is 7/1/07-6/30/12. In this five year period, the following accomplishments have been made:

The North Carolina Occupational Safety and Health Education and Research Center (NC OSHERC) located at the University of North Carolina, Gillings School of Public Health (SPH) in Chapel Hill, NC is an integrated center for training and research in occupational health and safety in . Occupational Medicine (OM) (Duke University), Occupational Health Nursing (OHN), and Occupational Safety/Ergonomics (OSE) (NC State University) all currently existing, as well as allied disciplinary programs in Occupational Epidemiology (currently existing), and Occupational Exposure Science (OES) component. A large and outstanding Continuing Education (CE) program is an important part of the NC OSHERC which has a Hazardous Substance Training (HST) program. The Director of the NC OSHERC is Bonnie Rogers, DrPH, Professor of Nursing and Public Health at the UNC SPH.

Dr. Rogers' primary role is to work with the Executive Committee (see below) to coordinate Center components to identify opportunities to expand and improve the overall strengths of the Center, provide well designed graduate education, training, and research programs and

enhance productive interdisciplinary collaborations among the core and allied programs. Dr. Rogers is responsible for administrative and budget oversight of the Center. Core and allied programs are regularly reviewed at Executive Committee and Advisory Board meetings, and input for improvement is implemented. Center activities are evaluated through achievement of trainee recruitment, graduation, and employment in leadership and practitioner positions, certification achievement, program accreditation, faculty and trainee productivity in publications, outreach activities, funded grants, conference/service participation, and satisfaction by trainees, graduates, employers, and stakeholders as discussed in the TPA proposals.

The Deputy Director of the NC OSHERC, Ms. Judy Ostendorf, helps to manage the day to day operations of the Center, coordinates Advisory Board and Executive Committee meetings, keeps meeting minutes to be able to track achievements, assists with trainee orientation sessions, and provides direction and guidance regarding NC OSHERC activities in the absence of the director.

The core, allied, and continuing education programs are managed by well qualified program directors, listed below. Program directors provide administrative and budget oversight for their respective programs and confer with Dr. Rogers when special resource needs arise. Together with the Center Director and the Deputy Director, they comprise the Executive Committee. The committee establishes policies for the NC OSHERC to ensure the overall quality of the individual program areas as integral components of the overall Center.. Curricular, research, interdisciplinary, outreach and diversity approaches, budgetary matters, expansion opportunities, changes and modifications needed, and new initiatives are discussed to address contemporary changes and needs in the occupational safety and health community. The committee meets regularly, generally 3-4 times per year.

Members of the Executive Committee

NCOSHERC Director	Bonnie Rogers, DrPH, COHN-S, LNCC, FAAN
Deputy Director	Judy Ostendorf, MPH, COHN-S
Occupational Medicine	Dennis Darcey, MD. MPH
Occupational Health Nursing	Bonnie Rogers, DrPH, COHN-S, LNCC, FAAN
Occupational Safety / Ergonomics	David Kaber, PhD
Occupational Epidemiology	David Richardson, PhD
Occupational Exposure Science	Leena Nylander-French, PhD, CIH
Continuing Education/Hazardous Substance Training	Kathleen Buckheit, MPH, COHN-S/CM

The NC OSHERC Advisory Board is comprised of a diverse group representing each core and allied program area plus business, labor, government, alumni, and academia. The Board meets annually to review the work of the Center, provide input into decisions impacting overall Center growth and expansion, identify potential funding sources for grant opportunities, and potential trainee practicum sites.

The NC OSHERC has graduated 38 NIOSH-funded trainees and more than 100 students in these degree programs. The NC OSHERC has redesigned the Center Wide brochure which discusses components of all program areas. This brochure has been distributed at all faculty/ERC attended conferences including AOHC, APHA, AIHA, National Safety Council, ASSE, and all state/local conferences. Additional recruitment strategies have been developed including 2 videos on SPH website, 1 featuring a student and 1 featuring faculty. Recruitment is done through the NC OSHERC Summer & Winter Institutes, and PHLP Website. An advertisement is placed on the OEM Listserve and occurs prior to application deadlines, twice a year. Several advertisements are in discipline specific vehicles. An electronic newsletter, News-E, was instituted semi-annually with distribution worldwide. The News-E features updates from all NC OSHERC program areas with articles and photographs highlighting recent activities and accomplishments. Through this resource, faculty, staff, and student awards and recognitions are acknowledged. Student projects, application deadlines, involvement in conferences and meetings, and media recognition are also included in each distribution. Reaching over 16,000 recipients worldwide, News-E includes advertising space for businesses and serves as a valuable marketing tool for the NC OSHERC Summer and Winter Institutes.

Interdisciplinary efforts have increased. The NORA Interdisciplinary Seminar Series has been implemented to discuss research pertinent to NORA and increased to 4 times per year. Trainees are required to attend all sessions. The NORA series is developed by NC OSHERC program directors on a rotating basis with nationally/internationally recognized speakers presenting. The series is presented on campus and webcast so that the larger occupational safety and health community can participate. The series has impressively registered nearly 3,000 participants worldwide in all states and 30+ countries. Nora topics presented during the past five years are shown in Table A.

Table A

Date	Seminar Title	Presenter/Agency	Attend
08/23/2006	Mercury and Chlorine Exposure	Woodhall Stopford, MD (Duke)	101
11/14/2006	Firefighter Physical Fitness	John Staley, PhD (UNC)	110
02/19/2007	Educational Needs Assessment for Pediatric Health Care Providers on Pesticide Toxicity	Leyla McCurdy, MPhil (NEEF)	37
05/16/2007	Standard/Universal Precautions	Kathy Kirkland, DrPH (AOEC)	212
08/22/2007	Utilizing a Social Marketing Framework for Moving Occupational Safety and Health into Practice	Max Lum, EdD (NIOSH)	129
11/15/2007	Community-Based Participatory Research with Vulnerable Populations	Linda McCauley, PhD	39
02/19/2008	Investigation of Dermal and Inhalation Exposure to Diissocyanates During Automotive Spray Painting	Kenneth Fent, PhD (UNC)	116
04/22/2008	Obesity in the Workplace	Brian Caveney, MD, JD (Duke)	272
08/20/2008	Occupational Health in a Globalized World	Marilyn Fingerhut, PhD (NIOSH)	152
11/12/2008	Ergonomics Research and Practice to	Patrick Dempsey, PhD (NIOSH)	84

	Promote Safety and Heath in Mining		
02/18/2009	Occupational Health Surveillance and Epidemiology in the DuPont Company	J. Morel Symons, PhD (DuPont)	85
04/15/2009	Occupational Mental Health and Recognizing the Signs of Stressed Employees	Judith Holder-Cooper, PhD (Duke)	243
08/26/2009	The Future of Work	John Howard, MD, JD (NIOSH)	188
11/04/2009	Prevention of Laboratory Animal Allergy	Gregg Stave, MD (Consultant)	117
02/03/2010	The Changing Face of Industrial Hygiene	Wayne Thomann, DrPH (Duke)	216
04/07/2010	Competencies and Practices for Effective Return to Work Coordination: Implications for Occupational Health Practice	Glenn Pransky, MD (Liberty Mutual)	219
08/25/2010	Injury Control Technologies for Medical Devices	Janine Jagger, PhD (UVA)	121
11/10/2010	Sleep Apnea after Exposure to Formaldehyde and Formaldehyde-containing Resin Dusts	Woodhall Stopford, MD (Duke)	151
02/09/2011	Tuberculosis in Healthcare Workers: A Global Perspective	Annelies Van Rie, MD (UNC)	165
04/13/2011	The National Occupational Research Agenda (NORA)	Sidney Soderholm, PhD (NIOSH)	120

The overall evaluation of the 20 seminars ranged from 3.4 to 3.8 (out of 4.0), with an average rating of 3.7. When asked if the topic was relevant and important to occupational safety and health, almost 95% said excellent or good (3.8 mean). Overall, the technology worked well very according to 85% of the viewers.

PUBH 785 Interdisciplinary Approaches in Occupational Health was more fully developed and increased from 2 to 3 credits. This course is required of all NIOSH trainees and taught by a wide array of expert interdisciplinary faculty. Content covers many topics to provide an overview of occupational safety and health, occupational health surveillance. Prevention, health promotion and protection, and work-life issues were added to the content. This is particularly important given the expanded role occupational health plays in work-life issues.

In 2010, the OM program received a full five year accreditation from the Accreditation Council for Graduate Medical Evaluation. The Review Committee noted: “Residents identified such strengths as faculty's willingness to work the residents' existing skills into the program and improve those skills, the balance between scholarship and clinical experience, faculty involvement in clinical care, and the interpersonal relationships between faculty and residents inherent in a small program.” Duke faculty and residents have been productive in the scholarly arena with over 100 publications and meeting presentations including collaborative efforts with other OM faculty and faculty from the NC OSHERC in Epidemiology, Occupational Health Nursing, and Safety and Ergonomics. Dr. Darcey developed an interdisciplinary prevention course integral to the curriculum in schools of nursing, medicine, physical therapy, and PA training programs at Duke and other schools, and that was shared at national meetings. A NC

OSHERC funded pilot project identified work restrictions during pregnancy, described compliance with work restrictions, and identified barriers to implementation. This led to improvements in Duke's Reproductive Health Consultation Service and is incorporated by employers served by Duke OM Clinic. The OM curriculum has been enhanced with the addition of a more comprehensive two week long GME and OM orientation program for new residents. OM outreach activities to translate research and education into the practitioner environment have been very active. Continuing education activities are provided in a number of venues including the internet with over 3,000 occupational health professionals around the globe enrolled in a daily forum discussing new and evolving occupational health issues and concerns. During the project period OM continuing educational offerings were provided to over 10,000 occupational health professionals in medicine, nursing, industrial hygiene, and safety. A number of practicum sites have been added over the last project period to enhance hands on learning in corporate medicine, clinical practice, government, and labor for OM and OHN. Dr. John Dement received the NIOSH Alice Hamilton Research Award and CDC's Charles C. Shepard Science Award nomination for the Assessment and Epidemiology Category for the manuscript, "An epidemiologic study of the role of chrysotile asbestos fiber dimensions in determining respiratory disease risk in exposed workers".

The OHN distance education option continues to grow. All School of Public Health and departmental courses are online as well as occupational safety and health cognitive courses trainees take. Trainees like this option. Three classes (ENVR 432, Occupational Safety and Ergonomics; PHNU 787, Industrial Hygiene; and PUBH 785, Interdisciplinary Approaches in Occupational Health) were developed in the innovative distance education format which is available to any student. A Certificate in Occupational Health Nursing academic program was developed and implemented in 2007. Eighteen students have been admitted to the program and 15 have graduated. Eight students will enter the program Fall 2011 and two from last year will take their last class this fall and complete the program in December 2011.

The OHN Program has been accredited by the National League for Nursing Accrediting Commission (NLNAC) since its inception and was reaccredited for the maximum period of eight years, through 2016. The SPH has been reaccredited by the CEPH for the maximum 7 year period. OHN faculty published 2 books, 12 book chapters, more than 40 articles in peer-reviewed journals, made more than 275 presentations, and served on numerous committees to support outreach activities. OHN trainees have published 27 articles and alumni have published more than 40 articles. The OHN Certification Review Course, taught by faculty 2-4 times a year, consistently shows a 97% pass rate. Dr. Rogers served as Vice Chairperson, Committee on Respiratory Protection for Healthcare Workers in the Workplace Against Novel H1N1 Influenza A for the IOM resulting in a publication in the New England Journal of Medicine and impacting practice for all healthcare workers. OHN faculty developed a competency matrix to measure competency achievement by students which has now been published and presented at International conferences. Curriculum topics added to OHN courses include the business context for occupational safety and health, mental health, case management, cost-benefit/effectiveness analysis, and demographic trend influences (e.g., aging, diversity).

Safety/Ergonomics faculty have published 56 archived journal publications, have received 12 research grants, and current students and alumni have published 42 articles. Epidemiology trainees have produced 17 publications and engaged in several faculty/trainee research

projects. UNC's OHN Program and NCSU's Safety and Ergonomic faculty and students collaborated on a Robert Wood Johnson Grant related to MSD exposures in RN's at five NC hospitals. Dr. Richardson is on the Presidential Advisory Board on Radiation and Worker Health, advising NIOSH on the program for dose reconstruction under the Energy Employees Occupational Illness Compensation Program. Dr. Richardson discussed occupational safety in the nuclear industry after the Fukushima disaster at several venues including the annual meeting of Physicians for Social Responsibility, Duke's Program in Asian Studies, UNC Program in Global Studies, and in a wide range of international media, including the BBC. OHN faculty and NC State Health Department are collaborating on a CDC funded project on respiratory protection for health care workers. This project is being conducted in 20 hospitals in NC and will have significant research to practice impact. The NC OSHERC funded 11 pilot projects. These are described in the Pilot Project section but projects are listed in Table B.

Table B

Project Title
Determining the Annual Risk of TB Infection among Health Care Workers in a Public Hospital in South Africa Using the Interferon Gamma Release Assay
Firefighter Fitness League Competition
Determining the Annual Risk of TB Infection among Health Care Workers in a Public Hospital in South Africa Using the Interferon Gamma Release Assay
Determination of Penetration Patterns of HDI Monomer and its Oligomers in Human Skin
Experimental Investigation of Ergonomic Interventions for Scaffold Use in Nuclear Power Facility Maintenance Tasks
Work Restrictions During Pregnancy: Review of Reproductive Consultations for Employees at a University Health System, 2001 to 2009
Can Criminal Background Checks Predict Employee Violence?
Quantification of AcHDA in Urine of Automotive Spray-Painters
MRSA Prevalence Among Workers at Conventional Industrial Hog Operations Compared to Antibiotic-free Hog Farms in North Carolina
Musculoskeletal Disorders of Veterinarians for Large Animals
Associations Between Methicillin Resistant *Staphylococcus aureus* (MRSA) Carriage and Occupational Exposures to Industrial Animal Production in the Eastern North Carolina

The IH core faculty published 107 scientific articles of which 21 were coauthored with ERC IH trainees, as well as 1 book and 3 book chapters. The Journal of Environmental Monitoring featured our trainees' research in its cover (Gaines *et al.*, JEM 12:591-9, 2010). IH core faculty and students delivered over 150 oral and poster presentations in both national and international meetings, and our NIOSH ERC IH trainees delivered 26 oral or poster presentations. Several IH students received poster, scientific achievement, or service awards at the American Industrial Hygiene Conference, including 3 first place poster awards. Two ERC IH trainees were selected as recipients of American Industrial Hygiene Foundation scholarships 2008-2009 and 3 of our IH trainees were successful in receiving funding from NC OSHERC for pilot projects. IH trainees participated in FEMMES (Females Excelling More in Math, Engineering, and Science) outreach program, which introduces young women (4th through 6th

grade) to math, science, and engineering, by directing a hands-on activity that highlighted industrial hygiene education and professional practices. IH joint research project with the Safety & Health Assessment & Research for Prevention Program of the Washington State Department of Labor and Industry to investigate diisocyanate exposures in automotive refinishing industry generated new and important knowledge on dermal and inhalation exposures providing protection for workers in the spray-painting facilities in this study.

Outreach and CE efforts have been outstanding. In addition to faculty and trainees generating enormous amounts of publications, service, and collaborative partnerships in the past 5 years, nearly 23,000 registrants attended CE courses. Physician attendance at CE conferences was increased by more than 10%. A new interdisciplinary approach to occupational health and medical education for the region is being planned and will be offered through a joint meeting of OHN and OM participants from NC, SC, and VA in 2012. Four new CE Courses were: OSHA 30-Hour General Industry for Healthcare, Toxicity of Chemicals for Health and Safety Professionals, Preparing for an OSHA Combustible Dust Inspection, and OSHA Recordkeeping. A new course developed was Ethics for Industrial Hygienists, a 2010 requirement for the certification and re-certification of the Certified Industrial Hygienist, offered 3 times as an online course. Several safety courses were offered as short (one-day) courses for a total of 19 courses over 5 months. NC OSHERC received accreditation by the US EPA and NC DHHS as a training provider and the CE Director as a certified Lead Renovation, Repair, and Painting (RRP) trainer and certified RRP renovator. NC OSHERC is the only training provider accredited in NC to teach the RRP course in Spanish. The CE Director was also accredited as an instructor for Supervisor and Worker Lead Abatement courses. Our CE program has offered training to more than 22,000 participants in 690 offerings often with tuition waivers because of the difficult economy.

The CE director was certified in 40-hour HAZWOPER Technician Level and Incident Command and assisted with teaching the HAZMAT courses during this period. The Telecommunications HazMat Specialist Technician Certificate Program was developed with AT&T HazMat project managers and NC OSHERC HST faculty in 2010 for telecommunications workers who respond in disaster situations as HazMat responders. They must have unique skills as Telecommunications Specialists and the additional training and skills of HAZMAT responders. NC OSHERC graduated 15 AT&T employees from this Certificate Program.

All faculty have been engaged in international partnerships to further expand the knowledge base of occupational safety and health globally. These activities are described in the Outreach section.

Minority recruitment efforts have increased in all program areas. For example in the Occupational Health Nursing Program contact has been made to several minority professional associations and colleges including the Black Nurses Association, Hispanic Nurses Association, the Indian Tribe Education Organization, and the American Assembly for Men in Nursing, with fall visits scheduled for Triad National BNA of Cabarrus County, Charlotte BNA, and Central Carolina Council, all NC local chapters of the National Black Nurses Association. A proactive program is underway in all departments. Recruitment ambassadors have been secured representing nursing alumni across the country and they will actively recruit minorities. Encouraging minorities to apply is on the brochures and NC OSHERC website. The Continuing Education Program has offered tuition waivers to minorities at local universities. Offers for free training have been accepted by the NC Solid Waste Division, increasing the minority

participation. NC OSHERC contacted every state Environmental Health Department and many local agencies in the region. Every Black and Hispanic/Latino Chamber of Commerce in the Southeast and the Governor's Office on Hispanic Affairs was contacted for marketing opportunities to businesses that had employees who needed HST courses and to provide the awareness of NC OSHERC Programs. Additional diversity outreach was provided to the following: UNC Minority Health Conference; NC A&T State University, a HBCU; and several Native Indian tribes with provision of occupational safety and health materials and services.

We have conducted a survey and needs assessment of alumni and continuing education customers in early 2011. The survey results were very positive and indicate high satisfaction with both academic and continuing education courses. Of those responding, 91% of current students/alumni rated their educational experience at the NC OSHERC as very good to excellent. They also rated satisfaction with interdisciplinary activities (orientation, NORA seminars, joint projects and research experiences, walkthroughs) good/excellent (94%) and cognate courses (toxicology, IH, Safety/Ergo) as good to excellent (89%). Distance education was rated as excellent/good (95%). Trainees have commented that the knowledge attained helped to reduce worker injury and illness and one indicated by as much as 70% and reduced lost work days by 96%.

Respondents to the 2011 NC OSHERC survey commented that the educational programs were comprehensive, covered many different topics, and had outstanding faculty. Other overall comments included: "NC OSHERC is professionally and intellectually stimulating"; "well organized, cutting edge education based on solid evidenced-based research"; and all courses have been well organized, content appropriate, and class work rigorous." One person stated, "I highly recommend the program to my colleagues. It is built for the working professionals and the interaction with the different disciplines was very valuable," which confirms the fact that most people hear about the NC OSHERC by word of mouth from a colleague. Respondents' comments very favorably about the academic programs. For example, comments about the OHN Program included: "Excellent—well organized and comprehensive occupational health nursing program;" Excellent instruction by Bonnie Rogers, Sue Randolph, and Judy Ostendorf." Many people felt the OHN courses were the most useful and liked the worksite tours at other companies. Others liked the occupational health cognate courses in industrial hygiene, occupational safety and ergonomics, and industrial toxicology. Several stated that the interdisciplinary activities were useful as well; one person commented, "Interdisciplinary focus; I particularly enjoy working with other fields of study such as physicians, industrial hygienists, safety, and ergonomists".

People who attended continuing education programs (CE) from NC OSHERC were highly satisfied with the overall programs offered. Respondents commented that "NC was an excellent experience. I encourage more of my colleagues to take advantage of this wonderful opportunity"; "Please continue to offer this service. The level of professionalism within the field need to continue to expand and is urgently needed"; and "Occupational health and safety professionals are aging. Exposures and exposure assessments are becoming more complicated. The ERCs are absolutely necessary to train the next generation of OSH professionals.

NC OSHERC OUTREACH

The NC OSHERC provides and will continue numerous outreach activities across program areas. The Center conducted a survey/needs assessment of graduates in April 2011 revealing high satisfaction ratings and future needs and challenges for occupational safety and health (OSH) for the next 3-5 years.

Occupational Medicine (OM) Residency Program faculty continue to significantly impact all disciplines of OSH practitioners through outreach. All provide leadership for and develop and teach for the Southeast Atlantic College of Occupational and Environmental Medicine (SEACOEM) Annual Symposium. Dr. Caveney is President; Dr. Darcey, OM Program Director (PD), is on the board. All faculty teach at bimonthly seminar/journal clubs (60 hours annually), inviting Research Triangle Institute, NIEHS, Chemical Industry Institute of Toxicology, EPA, OSH faculty, trainees, and professionals to lecture and attend. Over 10,000 OSH practitioners have attended CE offerings. All faculty teach courses in Duke's Schools of the Environment, Medicine, and Nursing and developed an interdisciplinary prevention course integral to the curriculum in schools of nursing, medicine, physical therapy, and PA training programs at Duke and other schools, and that is shared at national meetings. Residents and faculty conduct NORA-related research that translates into practice and leads to improvements in OSH. A NORA funded Pilot Project identified work restrictions during pregnancy, described compliance with work restrictions, and identified barriers to implementation. This led to improvements in Duke's Reproductive Health Consultation Service and is incorporated by employers served by Duke OM Clinic. Dr. Lipscomb expands her pneumatic nail gun injury research, translating findings into practical industry improvements in construction that led to better understand the mechanism of injuries and significant risks of the contact trip triggering mechanisms through collaborations with United Brotherhood of Carpenters and Joiners and Homebuilders Associations in NC and MS. In response, the Carpenters' Joint Apprenticeship Training Program in MS initiated a nail gun-training component for entry-level apprentice carpenters. Findings were shared with trade associations, International Staple and Nail Tool Association, and presented at national meetings focused on construction safety. An ANSI standard change now calls for shipping framing nailers with sequential triggers. However, contact triggers remain available and more research (Center to Protect Workers' Rights NIOSH Cooperative Agreement) focuses on evaluating training and triggering mechanism changes in preventing injuries.

Dr. Caveney served on ACOEM's Committee to update the position statement on "Return to Work for Attending Physicians", which was officially adopted and published by ACOEM. This project has great impact on OEM physician practice. He was also selected for the 2009-2010 North Carolina Medical Society Leadership College, conducting a special project to advance the field of OEM and organized medicine. Residents have written book chapters in Occupational Injuries and Illnesses for Lexis-Nexis, a 3-volume treatise for lawyers and non-physician workers' compensation insurance professionals assessing elements of causation and impairment evaluation. Dr. Caveney is Editor-in-Chief. This reference is a valued resource that impacts greatly on workers compensation practice nationally. Dr Darcey, Program Director (PD), completed a web-based medical CE program on health hazards of toluene diisocyanate (TDI) for all practicing OSH professionals. This is a joint project with ATSDR and NC Department of Health and Human Services (DHHS) after researching TDI exposure and health effects in 5 NC communities.

All faculty continue applied research that will have great impact on the practice of OSH professionals that currently numbers over 20 funded projects. Dr. Darcey and two OM trainees conducted a 2010 survey update of health and safety practices, medical surveillance, and environmental and biological monitoring for the global cobalt manufacturing industry supported by the Cobalt Development Scientific Advisory Committee. This is critical to conduct a worker health risk assessment pertinent to regulatory requirements for the European Union, providing recommendations for OM physicians coordinating medical surveillance and environmental and biologic monitoring, standardizing and centralizing monitoring programs, installing engineering controls to reduce worker exposures, and re-evaluating the effectiveness of worker training and respirator use. OM physicians participate in consulting activities for regional industries performing hazard assessments and preventive measures to remediate these hazards, including recent assessments of a dermatitis cluster in a steel mill and an asthma outbreak in a tire manufacturing plant. All faculty have developed academic courses for Duke and UNC medical students that may impact on students' career choices and provide a skillset that can translate into their primary care practice. Students participate in clinical evaluations and lectures, learn to conduct database searches about OSH, visit industrial sites, and complete an occupational hazard project.

Dr. John Dement received the NIOSH Alice Hamilton Research Award and CDC's Charles C. Shepard Science Award nomination for the Assessment and Epidemiology Category for the manuscript, "An epidemiologic study of the role of chrysotile asbestos fiber dimensions in determining respiratory disease risk in exposed workers", June 2009, and was an external reviewer for the Institute of Medicine's, "Review of the NIOSH Research Roadmap On Asbestos and Other Elongated Mineral Particles", July 2009. Dr. Hester Lipscomb recently completed a term on the NIOSH Board of Scientific Counselors and is on the NORA Construction Sector Research Council. Dr. Wayne Thomann is Chair of the NC Radiation Protection Commission and on the Environmental Health Committee of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Dr. Sandy Stopford is on the NC Science Advisory Board, making recommendations limiting emissions of toxins to protect the NC citizens, on an EPA expert panel to conduct a risk assessment of dioxin exposures to ceramicists, is the toxicology consultant to the Art & Creative Materials Institute, and is responsible for the toxic risk assessments of over 90% of the children's and fine arts materials sold in the United States (US). Dr. Bonnie Rogers served as the only non-physician member on the ACOEM Ethics Committee and helped revise the Code of Ethics.

Occupational Health Nursing (OHN) Program faculty are all involved in outreach activities impacting the OSH practitioners. The OHN Certification Review Course, taught by faculty 2-4 times a year, consistently shows a 97% pass rate, elevating the OHN status in the workplace and preparing OHNs for more critical and complex interdisciplinary responsibilities. The OHN: Introduction and Review of Principles and Practice course is taught by OHN and interdisciplinary faculty and is reported by participants and employers to prepare new OHNs and OHNs with expanding roles with skill sets and confidence to accept new and evolving workplace challenges. Dr. Bonnie Rogers, PD, Susan Randolph (faculty), and Karen Mastroianni (OHN graduate), co-authored a book, *Occupational health nursing guidelines for primary clinical conditions*, 4th edition, (2007) that is widely used as a protocol guide for OHNs and physicians in practice and academic institutions. The text has been translated into Portuguese and several chapters into Japanese. All faculty deliver presentations at many professional conferences

including the International Commission on Occupational Health (ICOH) and American Association of Occupational Health Nurses (AAOHN). The NC State OHN Consultant, an OHN graduate, teaches in the OHN Intro course and is on the OHN Program Advisory Board.

Integrating OSH within curricula with of other institutions and providing materials and consultation to other institutions is evident by the extensive use of Dr. Rogers' textbook *Occupational and environmental health nursing: Concepts and practice* (3rd edition is in press) used worldwide by OHNs in practice, faculty in other universities, and other ERCs as a textbook within existing curricula. Dr. Rogers has consulted with The University of Colorado in Denver about implementing OHN courses into the curriculum. She and Ms. Buckheit collaborated with and provided speakers for educational programs, consultants who assisted in developing medical surveillance, and training for the NC Agromedicine Institute, East Carolina University (ECU), which is a formal partnership of NCSU, ECU, NC Agricultural and Technical State University (NC A&T), NC Cooperative Extension, and the Eastern Area Health Education Center. The Institute promotes the environmental and OSH of agriculture, forestry, and fisheries' communities through research, education, and outreach. Labor and management leaders participate with faculty. Allen McNeeley, Director of NC OSHA, and Tom O'Conner, a labor leader, serve on the NC OSHERC Advisory Board. Mr. McNeely teaches Worker Safety and Health and Mr. O'Conner teaches Labor Perspectives in PUBH 785, Interdisciplinary Approaches to Occupational Health course.

Collaboration with professional and scientific associations is demonstrated by the numerous activities of the OHN faculty. Dr. Rogers has served in leadership roles with numerous professional and scientific societies. Her many services to the Institute of Medicine (IOM) most recently include: Vice Chairperson, Committee on Respiratory Protection for Healthcare Workers in the Workplace against Novel H1N1 Influenza A, and Member of Standing Committee on Personal Protective Equipment Compliance, and Co-Chair, Respiratory Protection Curriculum for OHN Programs. She is an Advisory Board member for the National Environmental Education and Training Foundation; current Chair, National Occupational Research Agenda (NORA) Liaison Committee; and member, NIOSH's National Occupational Safety and Health Professional Workforce Assessment Task Force. She is Vice-President of the ICOH and Ms. Randolph is Secretary for ICOH's Scientific Committee on OHN. Dr. Rogers was recently appointed to the Board of Scientific Counselors by the DHHS Secretary**,** Kathleen Sebelius, and appointed Chair by Dr. John Howard. She and Ms. Randolph are AAOHN past Presidents and Ms. Buckheit served as Board Member. Ms. Randolph is in her second term on the NACOSH Advisory Board. Ms. Ostendorf is Co-Chair of the Ergonomics Center of NC (ECNC) Advisory Board. Three faculty served on the AAOHN Foundation Board, securing funding for annual research and education grants awarded to OHNs nationwide. All faculty serve on several AAOHN Committees.

Two academic faculty and several adjunct faculty are members of the Education and Standards Committee of the NC Association of Occupational Health Nurses (NCAOHN), responsible for the identification of current topics, lecturers, and evaluations of educational programs for the semi-annual state conferences, each attended by over 100 OHNs from NC, SC, and VA. As co-sponsor, the NC OSHERC provides equipment, speakers, technical, and on-site operational assistance. For the past several offerings, these programs have received AAOHN's Best Educational Offering Award. Faculty frequently present topics at the national, state, and local AOHN conferences. Delivering OSH awareness seminars to undergraduate programs, Ms. Ostendorf

teaches at the UNC-CH School of Nursing three times each year about OHN for undergraduate awareness of the discipline and the opportunity to continue their education in this field. Delivering to labor, business, and community organizations, two faculty teach at the annual Best Practices Conference, sponsored by the NC DHHS and Local Emergency Planning Committee in NC for OSH practitioners and businesses leaders. Dr. Rogers discussed OSH issues at a high school in Raleigh, NC and was able to assist the school in obtaining an AED from a local hospital as an in-kind contribution.

Activities that facilitate the translation of research to practice include a project funded by NIOSH. Dr. Rogers, PI, is currently working with Ms. Buckheit on the respiratory protection project among health care Workers (HCW) in 20 NC hospitals. This will directly impact the way HCW use personal protective equipment. An article is being prepared related to research that Dr. Rogers, Ms. Ostendorf, Ms. Buckheit, and Dr. Mirka (NCSU OSE) completed related to nurses' exposure to musculoskeletal disorders that was conducted at five NC hospitals. Dr. Rogers is a Co- principal on a Center for Excellence in Health Promotion Work-Life Grant, a collaborative effort between the ERC, Health Behavior/Health Education, and The Injury Prevention Research Center. All of these projects provide research opportunities for students, impacting roles of OSH workers.

Occupational Safety and Ergonomics (OSE) Program faculty are involved in substantial outreach which impacts OSH practitioners, including service in editorial positions for journals, delivery of focused-training workshops to labs, and participation in national and international conferences. Dr. Kaber is track editor for the *Journal of Cognitive Engineering and Decision Making* and Associate Editor for the *IEEE Systems, Man & Cybernetics.* Dr. Couch provided radiation safety training for the Army Research Lab and taught CE courses in industrial hygiene and lab safety for NC OSHERC. Major conference participation and presentations included the *International Ergonomics Association* (IEA) Congress, the Annual Meeting of the *Human Factors & Ergonomics Society* (HFES), the *Applied Human Factors & Ergonomics Conference* and the *Applied Ergonomics Conference*. Tours of NCSU Ergonomics Laboratory (Ergo Lab) are given to practitioners of workplace training, students groups of local secondary institutions, and Mechanical Engineering faculty and high schools received access to the driving simulator for science fair studies. A standing offer continues to NC A & T, a NIOSH TPG, students to visit the NCSU Ergo Lab. Communicating with Dr. Zongliang Jiang (NC A&T Industrial Engineering), Dr. Kaber provided guidance on seeking funding as a TPG. Extensive collaborations exist between NCSU and UNC for OSH coursework development and delivery to students. UNC offers two interdisciplinary safety courses that support OSE student training in occupational health and industrial toxicology. NCSU offers several OSE courses via distance education, including human factors in systems design and occupational safety engineering, which other disciplines take as electives. Faculty and students collaborated with the Biomedical Engineering Department in labs as part of a biomechanics course instructed by Dr. Mente and using Ergo Lab equipment. Faculty enhanced the curriculum targeted at practitioner development, including occupational ergonomics and human performance modeling courses, and gave presentations at other academic institutions. Presentations describe OSE programs, approaches to degree program development and student instruction, and research. Dr. Kaber visited several universities in Thailand (Chulalongkorn, Thammasat, and Khon Kaen) and US institutions (Texas Tech, Iowa State and University of Michigan-Dearborn and Virginia Tech) to present information on the Department of Industrial & Systems Engineering and research through the OSE Program. He

was a Khon Kaen University visiting scholar, presenting ergonomics courses to Thai graduate students, and jointly supervised student research projects with Thai faculty. OSE Program trainees gave presentations on Ergo Lab research to Psychology faculty and graduate students through meetings of the Human Factors and Ergonomics Society (HFES) Student Chapter. Dr. Hsiang was visiting faculty at Texas Tech. Faculty serve in leadership positions for international technical societies and local chapters of the same organizations. Dr. Kaber served as Chair of the Cognitive Engineering & Decision Making Technical Group (TG) of HFES and developed and directed programs from 2009-2011. Dr. Kaber was President of the Carolinas Chapter of HFES and is currently a Chapter Director. In these roles, he has organized many professional presentations for Chapter members on human factors and safety in various types of complex systems. Dr. Kaber delivered research presentations to the chapter and served on the advisory board for the Ergo Council of NC (ECNC) for several years.

With respect to translation of research activities to practice, OSE Program faculty and students conducted a laboratory-based experiment for the NC Department of Transportation on the potential for driver distraction due to roadside logo signage design. The results of this work were then translated into policy statements for actual roadway facility development. Students conducted research with Liberty Mutual Research Center on product container design (detergent bottles) which translated to recommendations for manufacturers. Other trainees conducted applied research with small veterinary clinics and NCSU College of Veterinary Medicine identifying ergonomic risk factors and making recommendations for facility design and clinician training.

It is anticipated that the OSE program will maintain outreach activities in all the areas described above, including faculty participation in editorial roles for high impact publications, faculty and student contributions to national and international scholarly meetings, Ergonomics Lab tours and access for secondary school student projects, faculty interdisciplinary collaboration with UNC and other academic departments at NCSU in coursework development and delivery for trainees, communication with faculty at other institutions regarding OSE curriculum development and potential research collaboration, and service in leadership roles for technical organizations. It is also expected that OSE faculty will continue to support the NC OSHERC Continuing Education (CE) Program through instruction of courses as part of the Winter and Summer Institutes.

Occupational Exposure Sciences/Industrial Hygiene (IH) Program core faculty are involved in several educational and outreach activities on national and international levels including conference organization, grant and manuscript reviews, and consultation. Dr. Nylander-French (PD) has served on the ACGIH Biological Exposure Indices Committee since 2000, developing guidelines about chemical agents in IH practice and for use by other OSH professionals to protect worker health. Dr. Pleils, a founding member of the Scientific Advisory Board for the International Association for Breath Research (IABR), organizes its international meetings including Italy in 2011. He is on the international scientific committee for the Submarine Air Monitoring and Air Purification organization that revolves around human sustainability in artificial atmospheres, including US (NASA) and European spaceflight organizations. Faculty published 107 scientific articles, of which 20 were co-authored with NIOSH IH trainees, and 1 book and 3 chapters. Faculty and students delivered over 175 presentations for both national and international meetings.

IH joint research project with the Safety & Health Assessment & Research for Prevention Program of the Washington State Department of Labor and Industry to investigate diisocyanate exposures in automotive refinishing industry (supported by NIOSH R01-OH007598) generated new and important knowledge on dermal and inhalation exposures and urine and blood biomarker data related to external exposure levels. Data from inhalation exposure levels and means to provide protection for workers was provided to each of the spray-painting facilities in this study. Research findings resulted in 11 published and 3 submitted manuscripts. This also generated collaboration with the University of Washington to investigate the effectiveness of protecting clothing to prevent diisocyanate exposure (NIOSH R01-OH009364).

IH trainees have also been involved in outreach activities by delivering 26 oral or poster presentations. J. Thomasen delivered a Student Spotlight Presentation at the AIHA Carolinas Section Conference in 2010, providing most current scientific knowledge on monitoring air and skin exposures to diisocyanates. S. Flack and J. Thomasen participated in FEMMES (Females Excelling More in Math, Engineering, and Science) outreach program, introducing young women (4^{th} - 6^{th} grade) to math, science, and engineering by directing a hands-on activity that highlighted IH education and professional practices.

Occupational Epidemiology (OE) Program PD, Dr. Richardson, is on the Presidential Advisory Board on Radiation and Worker Health, advising NIOSH on the program for dose reconstruction under the Energy Employees Occupational Illness Compensation Program. He chairs the Working Group on Scientific Issues of the Advisory Board and serves on other advisory committees, including: the Monographs Program of the International Agency for Research on Cancer, the Scientific Committee on Biological Effectiveness of Photons as a Function of Energy (SC 1-20) of the US National Council on Radiation Protection and Measurements, and recently served as a member of an expert panel on formaldehyde for the National Toxicology Program, Report on Carcinogens, NIEHS. He also serves the scientific community as Associate Editor for three journals: *Occupational and Environmental Medicine*; *American Journal of Epidemiology;* and *Environmental Health Perspectives*. He contributes to OSH capacity-building efforts in developing countries through the Committee on Capacity Building in Developing Countries, ISEE.

Faculty are prominent in scientific communication: Dr. Gammon is Associate Editor of the *American Journal of Epidemiology*; Dr. Peden is Associate Editor in charge of occupational diseases for the *Journal of Allergy and Clinical Immunology*; Dr. Wing speaks at community workshops on environmental and occupational health justice issues across the US; Dr. Dement, Duke OMR Program, serves on a committee at the Hanford Nuclear Site investigating health concerns of exposures at hazardous waste tank farms. Dr. Richardson discussed occupational safety in the nuclear industry after the Fukushima disaster at several venues including the annual meeting of Physicians for Social Responsibility, Duke's Program in Asian Studies, UNC Program in Global Studies, and in a wide range of international media, including the BBC, MSNBC, Canadian Public Radio, and Japan's NHK broadcast. He has also played a role in communication for cohort study design to World Trade Center (WTC) Responder Health Consortium, WTC Medical Monitoring and Treatment Program, Mt. Sinai School of Medicine, NY (2010), discussing "Long-term follow-up of the Japanese atomic bomb survivors: Insights for the WTC Medical Monitoring and Treatment Program." For NC DHHS, He presented "Leveraging linkages: Emergency department data for environmental and occupational health

surveillance" about wider use of electronic data for surveillance. Providing more immediately practical benefits, Dr. Marshall, PI of a large cohort of cadets in the US military academies, is investigating Anterior Cruciate Ligament tears, disabling knee injuries common among active-duty military personnel. This is of immediate interest to the armed services and targeted to affect training methods.

The Continuing Education (CE) Program PD serves on several Advisory Boards: NC A&T, a HBCU and NIOSH TPG, providing equipment, curriculum advice, consulting for grant applications, editing of safety manuscripts, and providing free registrations for students to complement their academics and for faculty to maintain professional certifications; NC Emergency Management Systems (EMS) Rapid Response Teams (RRT) providing training advice and participating in drills and critiques; NC Pesticide Surveillance Committee, providing reviews and medical surveillance recommendations; SouthOn Occupational Injury and Illness Task Force identifying opportunities for data collection and analysis; and NC State Annual Ventilation Conference providing curriculum review, marketing, speakers, and equipment. Ms. Buckheit collaborates with Purdue University, a NIOSH TPG, on course materials and developing new offerings such as a revised IH Sampling course. Course materials and equipment are provided to several academic and government institutions, such as University of South Florida (USF) Sunshine ERC for annual collaboration for Hearing Conservation Courses. Equipment and faculty were provided to NIEHS for a Respiratory Protection course and to the NC Department of Environment and Natural Resources (DENR). The PD provides speakers and equipment for the regional AIHA and ASSE conferences. She is very active in AAOHN on several committees (Fellows, Marketing, and Advocacy). She is active on the state and local AOHN Education/Professional Affairs Committees, a Board member, and Chair of the Communications and Research Committees. She writes on practice issues and produces state and local semi-annual Newsletters, and was honored with AAOHN Communications Award three times. She made over 20 OSH presentations and was a speaker for the 2011 UNC Minority Conference, which included high school students, discussing the various OSH careers. After severe tornado activity, she was called three times by NC EMS to ensure public health and safety through hazard awareness and medical surveillance in several communities. She speaks and provides presentations to OHNs throughout the Southeast for use at chapter meetings and workplaces. CHMM Review Course materials were given to Piedmont Chapter of the ACHMM for training their members. OSH professionals receive materials to develop ergonomics programs. Equipment is loaned to practitioners for their own training to clients and professional associations. She collaborates annually with two Southeast ERCs: University of Alabama at Birmingham (Deep South ERC) and the USF Sunshine ERC at the Annual Florida Workers' Compensation Institute to provide speakers for over 2000 interdisciplinary attendees, addressing several Research-to-Practice topics. She presented the practice approach to the findings presented by a NIOSH researcher on the Aging Workforce. The NORA Interdisciplinary Seminar Series, offered quarterly live and via webcast, with archives, is required for all NIOSH trainees and reaches thousands in the larger OSH community, facilitating discussions of research, networking, and interdisciplinary role integration. UNC CE and ABIH CM points are available. Nearly 3,000 attendees represented all US states and 19 countries and generated almost 100% excellent reviews.

INTERDISCIPLINARY INTERACTION

The administrative core of the NC OSHERC fosters the interdisciplinary interaction of all programs. Several strategies are used to accomplish this: orientation for trainees; an interdisciplinary occupational health course; integrated disciplinary coursework including field and class projects; outreach; the NORA interdisciplinary seminar series; and research experiences.

An annual orientation/update is held in August for all NIOSH-funded trainees. The Center director discusses the mission of the NC OSHERC, its relationship to NIOSH, and new Center initiatives. Each program director provides program update, trainees introduce themselves and get to meet and interact with each other and faculty from the different disciplines. In conjunction with the orientation, one of the quarterly live NORA Interdisciplinary Seminars is held with national or international speakers presenting, which all NIOSH funded trainees are required to attend. Each training program area Occupational Health Nursing (OHN), Occupational Medicine (OM), Occupational Safety and Ergonomics (OSE), Occupational Exposure Science (OES), and Occupational Epidemiology (OE) is responsible for suggesting speakers and topics. Seminars are live on campus and also webcast so distance education students, students from NCSU Safety/Ergonomics, Duke University OM, and others in the larger occupational safety and health community worldwide can attend and actively participate by using the chat function in Adobe Connect. After the seminar is webcast, it is archived so it can be viewed at a later time or viewed again. The seminar gives students an opportunity to learn about NORA-related topics and research, network, and develop critical questions and ideas. Several attendees share the webcast with peers at work. Attendees can obtain continuing education units (CEUs) through the UNC-Chapel Hill at a nominal fee. Certification Maintenance (CM) points from the American Board of Industrial Hygiene for certified industrial hygienists (CIHs) are also available for each seminar at no cost.

All NIOSH-funded trainees are required to take PUBH 785, Interdisciplinary Approaches to Occupational Health. In this interdisciplinary course, all course students (ERC and others) attend interdisciplinary-based lectures on-line; participate in discussion forums; complete a virtual walk-through of the animal facility labs at UNC medical school to identify hazards, describe prevention and control strategies, and make recommendations to improve worker health and safety. Students also complete a group paper and slides based on a NORA Sector. Students select an industry and specific hazard based on their interest (and approved by course faculty), and research and present their findings via PowerPoint slides on-line discussing interdisciplinary roles. The topics selected are varied and quite interesting; for example, Shelia Dowd (OHN), Karla Hamblin (OHN), and Meghan Rogers (Safety/Ergonomics) selected Hazards of Dentistry and the Role of the Occupational and Environmental Health Team); Kinley Taylor (Safety/Ergonomics), Chad Uy (Safety/Ergonomics), and Ally Vizanko (OHN) selected Hazards of Hotel Housekeepers; and Daniel Anderson (IH), Kathleen Brown (OHN), and Shawna Hutchins (OHN) selected Alaska Crab Fishing. Injury prevention and labor issues were of significant interest to the students and a lively debate on ethical issues in occupational health was superb!

Trainee interaction occurs from attendance by trainees in toxicology, industrial hygiene (IH), and safety/ergonomics courses (PHNU 787 – IH; ENVR/PHNU 423 - Industrial Toxicology; ENVR 432/PHNU 786 - safety/ergonomics; PUBH/PHNU 785 – Interdisciplinary Approaches to OH – previously described). Students from other disciplines (e.g., health policy and health behavior)

also take these courses. This coursework provides the student with the skills necessary to learn about and develop a good understanding of an interdisciplinary framework for service delivery and research to improve the health and safety of the worker and work environment. Students from all core disciplines, participate in field experiences, and joint walk-throughs, collaboratively work together to address problems in occupational health, and make joint presentations related to the problem. For example, in the safety/ergonomics course (ENVR 432) students gain an overview of occupational safety and health and ergonomics and MSDs. They are also able to describe the development of federal safety standards, explain the fundamental concepts of occupational safety, identify MSD risk factors, complete a hazard assessment, and collaborate to identify hazard prevention and control methods, utilizing an interdisciplinary team problem-solving approach. Students attend the interdisciplinary safety and ergonomics course online which includes lectures with PowerPoint and audio format, readings, written assignments, online quizzes, discussion forums, and interdisciplinary projects. One of the interdisciplinary team projects includes team identification of a MSD exposure as part of a work process. A problem-solving approach is used by the team to negate this exposure and describe an ergonomic program that would benefit the company and employees. The team develops a PowerPoint presentation and posts it to the course site to share with classmates. A past example of one team's project was the identification of grocery store cashiers' and baggers' MSD exposures. The team consisted of Shelia Dowd (OHN), Cindy Feltner (OM), and Brandon Finch (IH). This project reflects the type of outstanding interdisciplinary work the trainees will continue.

In the industrial toxicology course (ENVR/PHNU 423) taught jointly by Dr. Stopford (Duke OM) and Susan Randolph (OHN) and in the industrial hygiene course (PHNU 787) taught by Dr. Nelson Couch, CIH and Susan Randolph, with guest lecturers, students attend classes online (with chat rooms). The courses are designed for OM residents, OHNs, OSE, and OES/IH students and stress the development of problem solving skills using a multidisciplinary approach that involves the integration of specialists in all of the core disciplines. In the industrial toxicology course, students learn about chemical agents that can cause adverse health effects and develop basic problem-solving skills necessary to assess occupational and environmental concerns. Students attend classes online with synchronous chat sessions, and develop a PowerPoint slide presentation on a selected chemical or exposure situation (e.g., chromium, lead, latex allergy) providing an in-depth analysis of the risk, exposure assessment approaches, and prevention and control measures. Examples of joint student presentations are Dimethyl Sulfoxide (DMSO), P-phenylenediamine (PPD) in Hair Dye—Evaluation of Risk for Professional Hair Dressers, Chemical Exposures of Carbon Monoxide, Dimethylamine Borane (DMAB), Sulfuric Acid, Mercury/Hydrargyria, and Turpentine.

In the IH course, students learn about the basic concepts of industrial hygiene including anticipation and recognition of hazards in the workplace, evaluation or measurement of those hazards, and application of control and prevention strategies. Emphasis is placed on use of an interdisciplinary team (medicine, nursing, IH, and safety) to assess, evaluate, and control hazards. Teaching methods include lectures, discussion forums (role of occupational health team, material safety data sheets, control strategies), application exercises (noise, TWA/TLV, hazard control), self-assessment quizzes, group assignment--printing plant case study, and a final exam. For the group assignment, students answer a detailed set of questions based on various areas of the printing plant virtual tour. All groups complete Section 1 (general technical

assessment of operations and processes); then each group selects 1 more section: Section 2-Platemaking Room, or Section 3-Press and Packaging, or Section 4-Maintenance Shop. An 8 to 10 page paper is prepared addressing the specific questions in the corresponding section.

Trainees from all disciplines are encouraged to attend CE courses (tuition waived) sponsored by NC OSHERC. Trainees can attend a variety of courses offered at the Summer or Winter Institute, such as workers' compensation, basic or advanced industrial hygiene, advanced safety, toxicology, legal concerns, ergonomics, biohazard science, case management, hearing conservation, and respiratory protection. Typically about 25 courses are offered.

Faculty members from each program routinely lecture in courses and seminars in the other disciplines and serve on dissertation/thesis committees. For example, Dr. Bonnie Rogers and Susan Randolph (OHN) provide a lecture on health care worker hazards in the occupational epidemiology course; Pat Curran (IH), Tom Sluchak (Ergonomics), Carol Epling (OM), Judith Holder (Occupational Psychology) and Jon Wallace (Safety) provide interdisciplinary lectures in the OHN courses; Duke OM faculty/residents teach in the Interdisciplinary Approaches in Occupational Health course and Dr. Bonnie Rogers sits on the Duke OM Resident Advisory Committee. Faculty and trainees from the disciplines interact on several research projects. Students have worked with other students and faculty from OM, OE, IH, OSE, and OHN on research projects ranging from commercial fishing, construction, healthcare, to traditional manufacturing industry.

NC OSHERC PILOT PROJECTS

The goal of the pilot project program is designed to provide seed money for investigators to conduct short-term projects that may be new or creative characterization studies, those that are designed as research translation projects, or those that are testing out a new method or approach to scientific inquiry. In all cases the research will address the NORA priorities.

Program Administration

The program is administered by Dr. Bonnie Rogers, Center Director. The pilot project components include

1. Mechanisms to ensure preparation and appropriate announcement of availability of funds;
2. Mechanisms for scientific merit review; and
3. Mechanisms for record maintenance and follow-up of pilot projects results.

Pilot Projects

Mechanisms for Announcement

A call for proposals is made through electronic solicitation uses the following procedures. The call was sent to all NC OSHERC faculty, alumni, and trainees including our partners at Duke Occupational Medicine and Safety and Ergonomics at NC State University. Faculty are asked to distribute the announcement to others they view as potential investigators. We also cast a wider net for solicitation of potential investigators through, the Injury Prevention Research Center, the Center for Health Promotion and Prevention, the Institute for Public Health, the Health Sciences Schools at UNC, and NC A&T State University (TPG), a historically black university, and East Carolina University (TPG) and approximately 20 other universities. Professional OSH organizations are also contacted and include: AAOHN, AOHP, SEACOEM,

AIHA, ASSE, and HFES. An Email list is kept. This has resulted in approximately 20 solicitation inquiries and on average 8-10 applications annually. In addition, solicitation is sent through the UNC webmail to encourage investigators from other fields to apply. We review all applications and fund successful proposals generally ranging from $10,000 to $20,000 each.

The call for proposals includes:

- The goal of the pilot program as stated above with maximum duration of the projects (24 months);
- Examples of pilot/small projects such as:
    1. Provide initial support to develop innovative approaches/lines of investigation in the program areas;
    2. Allow exploration of possible innovative new directions in OSH sciences;
    3. Stimulate investigators from other fields to apply their expertise to OSH issues;
    4. Develop new mechanisms for external or multi-ERC collaborative partnerships to address emerging safety and health concerns;
    5. Provide initial support for a translational/research to practice project; and
    6. Support trainee projects.
- A copy of the NORA sectors/related priorities and notification to view the NIOSH website for further detail on the sector/priorities;
- Proposal:
    1. 1-page concept statement of the proposed work (single spaced);
    2. Abstract describing the faculty member's existing work (if applicable);
    3. Estimated total budget and timeline; and
    4. CV of lead investigator.
- Due date for proposal;
- Review criteria to include:
    1. Relevance to the goal/objectives of the grant (integration of health protection/health promotion) and NORA focus;
    2. Scientific merit;
    3. Track record of the investigator(s);
    4. Innovativeness;
    5. Likelihood of leading to future work; and
    6. Feasibility.

Mechanisms for Scientific Merit Review

Pilot projects' review were accomplished by constituting review panels comprised of at least three researchers with expertise in the field of occupational health and safety and

proposal review experience, including at least one member of the NC OSHERC Executive Committee. Reviewers were sent a letter that includes the following:

- The goal of the pilot program as stated above with maximum duration of the projects (24 months);
- Examples of pilot/small projects (described previously);
- A copy of the NORA priorities and notification to view the NIOSH website for further detail on the priorities;
- Submitted pilot proposals from investigators (as described above);
- Deadline date;
- Review criteria (stated above); and
- Review score sheets used to evaluate the proposals based on the criteria
- Scores are averaged and proposals are ranked accordingly.

Mechanisms for Record Maintenance and Follow-up

All reviews were summarized and put into a composite form listing all scores and a mean score and ranking for each pilot project along with related comments. These were reviewed by the NC OSHERC Executive Committee for selection. Investigators were notified by Center Director of the final outcome of selection. Review comments are provided on request. Successful applications must have IRB approval. Copies of all proposals along with documentation of their reviews, mean scores and ranking, and final actions are placed in a binder with a Table of Contents listing each proposal by category. Investigators who receive funding are asked to submit semi-annual reports on the progress of their pilot projects which are reviewed by the Center Director and coordinator. Projects are reported informationally to the Advisory Board. A final summary report of the project is required. A record of results for each pilot project selected for funding are handled by asking the investigator(s) to notify the Center if the research projects are submitted for or are funded, become a dissertation project, or if projects are published.

Program Evaluation

The Pilot Program Project are evaluated in several ways:

1. The number of responses received from solicitations;
2. The categorical areas responsive to NORA priorities;
3. The quality of the proposals as judged by the review scores;
4. Timely completion of the project;
5. Involvement of students in projects;
6. Interdisciplinary nature of the project;
7. Project outcome leading to support for larger funded projects; and
8. Research translation projects.

In September 2010, (the most recent request for proposals) three pilot projects were funded for about $13,000 each. Request for proposals were sent to over 20 universities, professional organizations and public agencies, and other additional private researchers as previously described. Seven applications were received from the Southeast region, including three from the NC OSHERC and two applications from outside the ERC: University of Alabama at Birmingham and NC Agricultural & Technical State University in Greensboro. The NC OSHERC pilot projects funded during the project period of July 1, 2006-June 30, 2011 are listed in Table C.

Table C: NC OSHERC Pilot Project funded 2006-2011

Year	Project Title	Researchers	Description
2006-2007	"Determining the Annual Risk of TB Infection among Health Care Workers in a Public Hospital in South Africa Using the Interferon Gamma Release Assay"	**Dr. Patrick Keller, MD**, Preventive Medicine Resident and MPH student, University of North Carolina at Chapel Hill and **Dr. Annelies Van Rie, MD, PhD**, Assistant Professor, Epidemiology, University of North Carolina at Chapel Hill	The aim of the proposed study is to use IGRAs to estimate the annual risk of newly established and transient *M. tuberculosis* infections in health care workers employed in a setting with high rates of TB and HIV. This methodology and baseline information could in future (RO1) be used to assess the effectiveness of TB infection control measures in prospective controlled trials within health care settings in sub-Saharan Africa. The proposed pilot project will provide the initial support to develop innovative approaches to the investigation of occupational risk of TB in sub-Saharan Africa, an issue of great importance on which only scarce information exists. The project is highly relevant and timely as demonstrated by the recent outbreak of XDR-TB in South Africa, in which 6 health care workers died. <u>Presentations:</u> 1. Concept sheet submitted and approved for funding by the Comprehensive International Program of Research on AIDS (CIPRA, South Africa) (research built upon collaboration developed through the pilot study): Scott L, Stevens W, Van Rie A. Investigating the value of Interferon-release to M. tuberculosis to predict TB disease during ART.
2007-2008	"Firefighter Fitness League Competition"	**Jim Porto, Ph.D, MPA**, Assistant Professor, HPAA and **John Staley, ABD, MS**, HPAA Student, University of North Carolina at Chapel Hill	The purpose is to work with the Town of Cary to develop an innovative, competitive fitness program modeled loosely on the National Football League. This intervention tests the belief that competition can be a major driver for improving firefighter fitness, subsequently reducing heart attack and other deleterious health outcomes. From the firefighters' perspective, this is the most practical means of designing a sustainable fitness intervention, as it allows flexibility and creativity by each shift-team, thereby instilling ownership in one's own fitness and overall health. The results of this study are quite promising, as paired t-test analyses of mean differences in pre and post (six months) intervention measures demonstrate improvement in systolic blood pressure (t= 2.11, p= 0.04), cardiovascular class (a measure of

			maximal VO_2 capacity controlling for age and gender) (t= -2.55, p=0.02), flexibility (t= -2.23, p= 0.03), and body fat percentage (t= 2.52, p= 0.01), as a measure of body composition. Future Research: A full evaluation is planned of all fitness and injury outcome measures over 18 additional months, and IRB approval was obtained to conduct focus groups with participating firefighters to assess their perspectives on study effectiveness. Dr. Staley is currently writing an R03 grant for submittal to NIOSH for a proposed longitudinal study of the 24 larger municipalities across North Carolina, including an assessment of existing workplace fitness programs and fitness and injury outcomes. Publications: 1. Staley J.A. (2009). "Get firefighters moving: Marketing a physical fitness intervention to reduce sudden cardiac death risk in full-time firefighters. *Social Marketing Quarterly*, 15(3),85-99. 2. Staley J.A. (2008). "The determinants of firefighter physical fitness: An inductive inquiry into firefighter culture and coronary risk salience". (Doctoral Dissertation). The University of North Carolina at Chapel Hill, 259 pages. Available rom: http://proquest.umi.com/pqdweb?RQT=403&DBId=G647#sform
2007-2008	"Determining the Annual Risk of TB Infection among Health Care Workers in a Public Hospital in South Africa Using the Interferon Gamma Release Assay"	**Dr. Annelies Van Rie, MD, PhD**, Assistant Professor, Epidemiology, University of North Carolina at Chapel Hill and **Dr. Patrick Keller, MD**, Preventive Medicine Resident and MPH Student, University of North Carolina at Chapel Hill	The aim of the proposed study is to use IGRAs to estimate the annual risk of newly established and transient *M. tuberculosis* infections in health care workers employed in a setting with high rates of TB and HIV. This methodology and baseline information could be used in the future (RO1) to assess the effectiveness of TB infection screening control measures in prospective controlled trials within health care settings. Because of the lower than anticipated participation rate among medical students (n=79), the researchers enrolled a higher number of health care workers (n=114), resulting in the expected total number of participants (n=193). The lower enrollment of medical students and the low HIV prevalence among medical students resulted in a spin-off project by medical students. They have started with the analysis and interpretation of the baseline data. Poster Presentations: 1. Baseline prevalence of latent TB infection amongst 5th year Medical Students: First report of a prospective longitudinal study to determine TB infection rates amongst Health Care Workers. L Noble, **P Keller**, K McCarthy, T Mosendane, M Tellie, F Venter, L Scott, W Stevens, **A Van Rie**. National TB conference "Working as One", 4-7th July 2007, Durban, South Africa; 2. Noble L, McCarthy K, Mosendane T, Venter F, **Van Rie A**. Baseline prevalence of latent TB infection amongst 5th year Medical Students: First report of a prospective longitudinal

			study to determine TB infection rates amongst Health Care Workers. South African TB conference 2009, Durban , South Africa; 3. McCarthy KM, Scott LE, Fakir P, Tellie M, Venter F, Stevens W, **Van Rie A**. "Occupational health screening using Quantiferon Gold among health care workers in high TB exposure settings: high IGRA values present a management dilemma". 2nd Global Symposium on IGRA, Dubrovnick, Croatia, May 2009. <u>Oral Presentations:</u> 1. "Does knowledge about HIV and TB make a difference? Wits Medical students' participation as subjects in research requiring HIV and TB testing". Y Hlaing, M Manyoni, Y Nyathela, U Ramkisson, R Suliman, Z Hlongwa, M Mugagadeli, N Omar, E Steyn, D Wineberg, **A Van Rie**, K McCarthy. University of the Witwatersrand HIV Research Day, Johannesburg, South Africa, November 2008. 2. Scott, L, Fakir P, McCarthy K, Mosendane T, **Van Rie A**, Venter F, Stevens W. QuantiFERON-TB Gold In-Tube OD readings around the cut-off value: what do they mean? 2nd Global Symposium on IGRA, Dubrovnick, Croatia, May 2009. 3. McCarthy K, Hlaing Y, Hlongwa Z, Manyoni M, Mugugadeli M, Nyathela Y, Omar Y, Ramkisson U, Steyn E, Suliman R, Wineberg D, **Van Rie A**. The impact of South African medical students' TB and HIV knowledge on their participation as subjects in research requiring TB and HIV testing. Research Symposium on HIV/AIDS: Research Action. Nov 2008, Johannesburg, South Africa. <u>Publications:</u> 1. **Keller P**, McCarthy K, Mosendane T, Tellie M, Venter F, Noble L, Scott L, Stevens W, **Van Rie A.** (2009). HIV prevalence among medical students in Johannesburg, South Africa. *South African Medical Journal*, 99 (2), 72.
2008-2009	"Determination of penetration patterns of HDI monomer and its oligomers in human skin" Completed May 2011	**Jennifer Thomasen, MSPH** , PhD student, Environmental Sciences and Engineering, University of North Carolina at Chapel Hill	Diisocyanates are a leading cause of occupational asthma in exposed workers. Inhalation exposure has been considered the primary route of contact and diisocyanate-induced sensitization (Type IV hypersensitivity) in exposed workers. However, more recently, concerns about the role of dermal exposure in diisocyanate induced sensitization and asthma have been raised. Dermal exposure to 1,6-hexamethylene diisocyanate (HDI) monomer and its oligomers in the automobile refinishing industry may occur via deposition of HDI-containing paint onto the skin during mixing and/or spraying, or by direct contact with the paint, freshly painted products, and/or contaminated surfaces. The researcher investigated penetration patterns of monomeric

			and polymeric 1,6-hexamethylene diisocyanate (HDI) in excised full-thickness human skin at 5, 10, 30, or 60 min after exposure. She observed that both monomeric and polymeric HDI were readily absorbed into the skin and that the composition of the clearcoat mixture may affect the penetration rate of the individual isocyanate compounds. The short-term absorption rates (10 and 60 min) for HDI monomer, biuret, and isocyanurate were determined and used to estimate the exposure time required to reach a body burden equal to the American Conference of Governmental Industrial Hygienists (ACGIH) inhalation threshold limit value (TLV) or Oregon State occupational exposure limit (OEL). Based on the short-term absorption rates for a slow-drying clearcoat after 10 min (1.33 μg/cm^{2}h) or 60 min (0.219 μg/cm^{2}h), she calculated that ~3 and 18 min dermal exposure, respectively, is required to achieve a dose of HDI equivalent to the ACGIH TLV. For biuret, the time to achieve a dose equivalent to the Oregon OEL for slow-drying clearcoat was much shorter (<14 min) than that for fast-drying clearcoat (274 min). Isocyanurate had the shortest skin absorption times regardless of clearcoat formulation (6 – 47 sec). These results indicate that the dose received through dermal exposure to HDI-containing clearcoats in the occupational setting has a significant potential to exceed the dose equivalent to that received through inhalation exposure at established regulatory limits. A critical need exists to monitor dermal exposure quantitatively in exposed worker populations and to re-evaluate regulatory exposure limits for isocyanate exposures. Additionally, the use of proper dermal protective equipment to reduce dermal exposures is necessary when working with these compounds. Presentations or Publications: 1. The researcher presented preliminary data at AIHce in Denver, Colorado on May 26, 2010. The abstract was entitled "**Thomasen, J** and Nylander-French, LA: Penetration Patterns of 1,6-Hexamethylene Diisocyanate Monomer in Human Skin." 2. The researcher (**Thomasen, J**) was selected to give the Student Spotlight Presentation at the AIHA Carolinas Section Fall Professional Development Course and Conference at the BMW facility in Greer, SC on Sept 30, 2010. The presentation was titled "Monomeric and Polymeric 1,6 Hexamethylene Diisocyanate in the Automotive Refinishing Industry – How should we monitor air exposures? Does it penetrate the skin?" 3. Poster presentation won Best Student Poster by the AIHA Volunteer Group, Dermal Project Team. AIHce in Portland, Oregon on May 18, 2011. The abstract was entitled "**Thomasen, J** and Nylander-French, LA: Dermal Penetration Patterns of 1,6 Hexamethylene Diisocyanate (HDI) Containing Clearcoats." 4. The researcher will present in Toronto, Canada at OEESC

			on June 6, 2011. The abstract is entitled "**Thomasen, J** and Nylander-French, LA: Penetration Patterns of Monomeric and Polymeric 1,6-Hexamethylene Diisocyanate in Human Skin. 5. The researcher plans to submit an article for publication in June 2011.
2008-2009	"Experimental Investigation of Ergonomic Interventions for Scaffold Use in Nuclear Power Facility Maintenance Tasks"	**Matt Diering,** MS Student in Occupational Safety and Ergonomics Program, NC State University.	Prior ergonomic evaluation of local nuclear power facility (NPF) maintenance jobs revealed tasks that pose significant ergonomic risks for workers. This evaluation also identified the need for engineering interventions to reduce risk exposures. Specifically, the findings of a "deep dive" analysis indicated that scaffolding tasks present ergonomic problems in terms of loads of lift and repetitive motions. For this research, two primary scaffolding operations will be investigated through ergonomics experiments: (1) connection of scaffolding pipes during scaffold assembly; and (2) scaffold planking. Two experiments are proposed to: (1) examine the biomechanical stresses placed on the body during the handling of different types of scaffold planking; (2) examine the design of alternative mechanisms for connecting scaffold pipes in an effort to reduce the potential for RSI. Hypothesis: For Experiment 1, the researcher expects that: (1) reduced plank weight will lead to a reduction in the compressive force at the L5/S1 joint in the low-back region during lifting tasks; and (2) eliminating the need to secure the plank to the scaffolding frame will reduce the amount of time spent in a forward-flexed posture. For Experiment 2, the researcher hypothesizes that: (1) there will be a marked decrease in the number of repetitions required to tighten the clamps due to the elimination of the current ratcheting mechanism; and (2) extreme wrist postures will be eliminated because of the removal of the ratcheting tool when tightening the clamp. The project involved an ergonomic evaluation of scaffold frame assembly and disassembly operations at Duke Energy nuclear stations, recommendations of ergonomic interventions in terms of equipment selection and design, as well as assessment of the affect of alternative equipment on scaffolder performance and exposure to ergonomic risk factors. An experiment was conducted in which a team of nine skilled scaffolders performed basic frame assembly and disassembly tasks using existing wood and metal planks with metal wire tie-downs and ratcheting frame couplers. This scenario was compared with scaffolder use of the same planks with industrial zip tie-downs selected based on ergonomic principles and adjustable lever-action couplers designed and prototyped as part of the project. The experiment collected time-to-task completion data, upper-extremity joint angles using

			electro-goniometers and muscles exertion levels using electro-myography. Results revealed that the plastic zip ties took less time to secure planks to scaffold frames, required less extreme and joint angles and lower forearm muscle exertion levels. The results of this research have been presented to Duke Energy Environmental Safety & Health officers; the use of industrial zip ties should be implemented in scaffolding operations in the near future. Duke plans to further investigate the use of the adjustable lever-action couplers in terms of performance. The current benefit of the new couplers is in reduction of repetitive wrist motion in frame assembly and the potential for cumulative trauma disorders, such as carpal tunnel syndrome. Patent Application: A patent application for the adjustable coupler technology and a master's thesis was prepared by Mr. Matt Diering (NIOSH trainee OSE program). The researchers prepared a conference proceedings paper published through the Human Factors & Ergonomics Society Annual Meeting in 2010. Publications: 1. Kaber, D. B. **& Diering, M. R**. (2009, December). Adjustable lever-action couplers (United States Provisional Patent Application). Pittsboro, NC: Lee Law, PLLC. **2. Diering, M. R**. (2009). Ergonomic Evaluation of Scaffolding Task Interventions for Power Plant Maintenance (Defended 12/09). Unpublished Master's Thesis. Raleigh, NC: North Carolina State University, Department of Industrial & Systems Engineering.
2009-2010	"Work Restrictions During Pregnancy: Review of Reproductive Consultations for Employees at a University Health System, 2001 to 2009" Completed	**Kristen L. Kucera, PhD, ATC, LAT** and **Diane Ballerino-Regan, MD, MPH, MS,** OM Resident; Division of Occupational & Environmental Medicine, Duke University Medical Center	Approximately 70% of women work during their pregnancy. Reproductive consultations are useful for women who continue to work during pregnancy. Work restrictions may be instituted for women working prior to or during their pregnancy in order to manage known and potentially hazardous exposures. Methods**:** A retrospective chart review was conducted for university health system employees who received reproductive consultations at the occupational medicine clinic from 2001 to 2009. Of the 103 reproductive consultation visits recorded in the clinic database, 91 visits were abstracted for 87 female employees. The information reviewed for each chart included the reproductive screening form, work restriction forms, clinician chart notes, and any follow-up documentation. Telephone surveys were done for the 52 reproductive consultation visits during 2007-2009. Nineteen employees agreed to participate (37% overall response rate). Summary of Results: Most common work exposures included chemical (58%),

			radiation/radioactive (48%), and infectious concerns (45%). About 76% received work restrictions, often more than one restriction including no spill clean-up (37%), lifting (31%), other chemical-related (18%), and/or cease use of or task (18%). Few employees had follow-up contact after the initial consultation visit (24%). The majority of the 19 employees surveyed reported a satisfactory reproductive consultation experience (16/19, 84%). About three quarters received a work restriction (74%); all employees followed the restrictions and felt that the restrictions protected them. All employees reported that restrictions were accommodated, however their experiences with supervisors varied. Conclusions: Given the nature of the restrictions reported for this group of university health system employees, it may be valuable to incorporate questions on common patient care activities or other work-related exposures that are likely to trigger a restriction. However, it is unknown whether the consultation was successful because there was no subsequent follow up of employees. Therefore, some formal follow-up after the consultation visit is recommended. Follow-up would provide an opportunity to assist individuals who may be experiencing difficulties navigating their work restrictions and detect any issues that have arisen since the initial consultation visit. Presentations: 1. **Kucera KL** and **Ballerino-Regan D** (presenter). Work Restrictions During Pregnancy: Review of Reproductive Consultations for Employees at a University Health System, 2001 to 2009. Poster presented at the 2011 American Occupational Health Conference (AOHC), Washington D.C. on March 26, 2011.
2009-2010	"Can Criminal Background Checks Predict Employee Violence?"	**Matthew Pierce**, Industrial Engineering, NC State University	The goal of this pilot study is to collect data that will inform the design of a future case-control study on employers' use of criminal background checks as a tool that will assess whether criminal background checks are an effective hiring tool for reducing employee violence. To fulfill this goal, The researcher originally proposed conducting 32 qualitative interviews by phone with HR personnel at employers from the 8 NORA sectors. Because of an extremely low response rate (about 3%), however, the academic supervisors and researcher agreed to modify the method for collecting data and created a short, web-based survey that included questions about employers' policies on criminal background checks and on maintaining records of workplace misconduct. This approach resulted in a more informative study because it will allow a much larger number of HR professionals to participate in the study and lead to a higher response rate. The

			decision to redesign the study was made in May and was the result of an unexpectedly low response rate to the telephone survey. From March to May, the researcher contacted approximately 200 employers and was able to set up and conduct 6 interviews. As a result of the low response rates, he limited the length of the interviews to 20 minutes, broadened the questions so participants were not asked to provide specific information about their own company, and removed requests for participants to share de-identified or blank misconduct records. Even with these changes, however, recruitment was difficult. The 6 interviews conducted were helpful in designing the new survey instrument. The researcher completed the new instrument in early June, and the new study design (along with the instrument) was approved by the IRB. The survey was administered to 124 members of local human resources associations in Virginia, North Carolina, South Carolina, Georgia, Tennessee, and Florida, recruited through local chapters of the Society of Human Resource Management (SHRM), a national association with almost 600 chapters and over 250,000 members. This new design provided more generalizable data than the original telephone survey and will better inform the development of the future case-control study. Data analysis and manuscript preparation are under way. The manuscript focuses on why employers run criminal background checks. This question is of interest because, in order to determine whether criminal background checks are effective, it is first important to understand why they are being used. Results from the survey suggest that employers use criminal background checks for a variety of reasons, but that the most frequently cited goals are to minimize 1) liability, 2) violence, and 3) theft. The manuscript will discuss whether there is any evidence to suggest that criminal background checks can achieve these goals.
2009-2010	"Quantification of AcHDA in Urine of Automotive Spray-Painters" Expected completion date: 12-01-2011	**Sheila Flack, PhD,** post doc student and **Zachary Robbins, BS, MS,** IH Student , University of North Carolina at Chapel Hill	The goal of this research study is to quantify monoacetyl-1,6-diaminohexane (monoacetyl-HDA) in the urine of 48 workers exposed to 1,6-hexamethylene diisocyanate (HDI) in the automotive refinishing industry. The measurements of monoacetyl-HDA will provide a better understanding of the overall exposure to HDI. The differences in levels of monoacetyl-HDA in workers' urine could indicate disparities in metabolism of 1,6-hexanediamine (HDA) and susceptibility to HDI exposure, which may be related to genetic differences in the *N*-acetyltransferase enzyme. To date, the researchers have prepared and analyzed standards of monoacetyl-HDA in water and control urine using gas chromatography-mass spectrometry (GC-MS). Additionally the researchers have analyzed standards of monoacetyl-HDA in water

			and control urine using liquid chromatography-mass spectrometry (LC-MS) which eliminates laborious urine pretreatment necessary for GC-MS analysis. They are developing a solid-phase extraction method for urine pretreatment for analysis of monoacetyl-HDA and other metabolites using LC-MS. They will use this new method to analyze 259 urine samples for monoacetyl-HDA and other HDI metabolites and correlate these levels to the inhalation and dermal levels of HDI as well to the urine HDA levels measured in samples collected from 48 spray painters exposed to HDI. Presentations or Publications: 1. **Zachary Robbins** - Master's Thesis Defense. Determination of aliphatic amines in urine as biomarkers of exposure to 1,6-hexamethylene diisocyanate and isocyanurate.
2010-2011	"MRSA prevalence among workers at conventional industrial hog operations compared to antibiotic-free hog farms in North Carolina" Expected completion date: June 30, 2011	**Christopher Heaney,** IH Student, University of North Carolina at Chapel Hill	Industrialized systems of food animal production are major sources of novel antimicrobial drug-resistant bacterial pathogens that along with emerging zoonotic viruses are among the most globally prevalent and emerging infectious diseases. Estimates of the burden of emerging infectious diseases in food animal production workers and household members are essential to identifying key risk factors of pathogen exposure and optimal points of intervention to reduce exposure and infection risks. Results of this cross-sectional study will help measure the prevalence of carriage of an emerging zoonotic pathogen (MRSA) in livestock workers and their household members in a region with intensive livestock production. Summary of progress: They have received IRB approval and are recruiting and enrolling participants from conventional industrial and antibiotic-free livestock operations at this time. Presentations: 1. Study overview presentations by invitation at: Johns Hopkins University, Dept of Environmental Health Sciences; East Carolina University, Department of Public Health; University of Iowa, Dept of Occupational and Environmental Health.
2010-2011	**"**Musculoskeletal disorders of veterinarians for large animals"	**Meghan Rogers,** Occupational Safety and Ergonomics Student, NC State University	Veterinarian practices represent a substantial and important service industry in the United States. Unfortunately, there is a high prevalence of musculoskeletal disorders (MSDs) among clinicians due to common tasks. To date, there has been limited ergonomics research to identify and analyze risk factors leading to veterinarian MSDs. This research seeks to systematically examine veterinary operations as a basis for reducing work-related MSDs. A preliminary study identified ergonomic risk factors associated with small animal operations. Due to size differences among animal patients, clinician working postures and required levels of muscle exertion may differ significantly in large animal

			veterinarian tasks. Therefore, this proposal is for an ergonomic study of large animal veterinarian operations as follow-on to the prior research. The study will involve a detailed task analysis and identification of high risk jobs for MSDs as well as violations of established ergonomic criteria. The study is expected to produce recommendations on interventions to improve veterinary tasks, which can be tested in follow-on studies. The overall goal of the present research is to improve the ergonomics and safety of large animal operations in veterinarian clinics and to reduce the potential for MSDs. The specific aims of the study include: 1) analysis of typical veterinary tasks for treating large animals and development of a taxonomy of MSDs associated with these tasks; 2) identification of risk factors for MSDs in typical veterinary tasks using both qualitative and quantitative methods; 3) identification of ergonomic principle violations in current veterinary tasks; and (4) recommendations of ergonomic interventions to improve veterinary task safety.
2010-2011 1	"Associations between Methicillin resistant *Staphylococcus aureus* (MRSA) carriage and occupational exposures to industrial animal production in the eastern North Carolina" Expected completion date: August 2012	**Leah Schinasi,** IH Student, University of North Carolina at Chapel Hill	Methicillin resistant *Staphylococcus aureus* (MRSA) is a dangerous bacteria that has evolved resistance to methicillin and other ß-lactam antibiotics. In 2003, a new strain of community acquired was detected and shown to be related to contact with livestock; especially pigs. This relationship might result from the sub-therapeutic application of antibiotics in livestock for growth promotion. The overall objective of this study is to expand knowledge of the relationship between occupational contact with livestock and MRSA carriage through the conduct of a case control study of admitted patients to Pitt County Memorial Hospital (PCMH), which is the largest tertiary care hospital in eastern NC, an area that is densely populated with industrial animal production facilities. PCMH screens all admitted patients for MRSA carriage. The researcher will prospectively enroll cases (individuals who screen positive for MRSA) and controls (patients that screen negative) and ascertain information on their occupational contact with livestock using structured in-hospital interviews. She will use conditional logistic regression models to compare the odds of MRSA carriage in participants with occupational exposure to industrially produced animals to the odds of MRSA carriage in participants without such contact. The researcher has been working on getting IRB approval which was received at the end of May. She expects to begin collecting data (conducting interviews with patients at PCMH) within the next couple of weeks.

OHN REPORT

The period covered by this report is 7/1/2007-6/30/2012.

- The OHN Program at the Master's degree level continues to grow indicating a need and desire for graduate training in OHN. The curriculum maintains study in the public health sciences, occupational health sciences, and nursing sciences core while the content reflects state-of-the-art information such as health promotion programming, case management, cost-benefit/effectiveness analysis, and demographic trend influences (e.g., aging, diversity). A survey was done April 2011 of our current students, academic graduates/alumni from 2006-2011 and results are discussed in this report.
- Twelve MPH students and one MS student graduated during the years 2006-2011. The OHN Program has added more than 120 Master's degree prepared occupational health nurses to the workforce. Graduates are readily employed in OHN in leadership positions in occupational health settings as managers, educators, practitioners, consultants, and researchers.
- Three classes were developed in the innovative DE format (ENVR 432, Occupational Safety and Ergonomics; PHNU 787, Industrial Hygiene; and PUBH 785, Interdisciplinary Approaches in Occupational Health). Therefore all classes, except PHNU 781: OHN I and PHNU 782: OHN II, are offered in the online format. The OHN courses were restructured to be offered on-campus for eight full days so that all on-campus, distant education, and certificate students (PHNU 781 only) can take classes together. This was a result of student input and Advisory Board discussion.
- A Certificate in Occupational Health Nursing academic program was developed and implemented in 2007. Eighteen students have been admitted to the program and 15 have graduated. Eight students will enter the program Fall 2011 and two from last year will take their last class this fall and complete the program in December 2011.
- One Certificate in OHN Program graduate applied to and was accepted into the MPH program spring 2011 and 2 more applications are in process.
- The OHN Program has been National League for Nursing Accrediting Commission (NLNAC) accredited since its inception and was reaccredited for the maximum period of eight years, through 2016.
- The SPH has been reaccredited by the CEPH for the maximum 7 year period.
- Recruitment strategies developed and these strategies have brought more than 30 inquiries for the year 2006-2007, 45 for the year 2007-2008, and 45 for the year 2008-2009, 40 for the year 2009-2010, and 52 for the year 2010-11. Most application requests are for the distance learning option; however, residential admission is healthy. Continued follow-up is done with each potential applicant throughout the application to admission process to enrollment which is labor intensive but fruitful in enrollment. Two students were admitted for Spring 2011 and six applications are in process for Spring 2012 semester. Five OHN alumni are Recruitment Ambassadors and assist in recruitment efforts. They live throughout the US and are available to attend meetings or classes in their locality to discuss the OHN Program and to assist with minority recruitment. A proactive minority recruitment plan was implemented. A specific

brochure targeting OHN DE has been developed and was used in meetings with nurses in the Black Nurses Association, one request for information resulted. The brochure states that "Minorities are encouraged to apply". One of our faculty discusses the role of the occupational health nurse with the UNC-CH community health nursing class at the School of Nursing three times a year. These classes include minority students of all races, who after class discuss program interest with faculty. We currently have enrolled five minority students (equaling 33.3% of our trainees) including one African American, one Hispanic, one Asian, four males, and one African American female. Males are considered a minority in nursing because only 5.4% of nurses are males according to a recent National Sample Survey of RN's (http://www.allnursingschools.com/nursing-careers/article/men-in-nursing

- Faculty have presented at the Minority Health Conference; this will be an annual event.
- The OHN Program continues to actively participate in the NC OSHERC continuing education/outreach efforts. We offer the "OHN Certification Review Course 3-4 times per year and the OHN: An Introduction and Review of Principles and Practice" course every year. Three OHN faculty are on the Education and Standards Committee of NCAOHN which plans the continuing education programs for occupational health nurses in the state offered twice a year. The NC OSHERC co-sponsors this meeting semi-annually, providing technical and on-site operational assistance.
- International efforts are demonstrated by OHN faculty attending and speaking at the International Commission on Occupational Health (ICOH) conferences in Milan, Italy; Glasgow, Scotland; and Cape Town, South Africa.
- Dr. Bonnie Rogers was elected Vice-President of the ICOH and oversees 34 scientific committees and the ICOH Triennial Congress 200 Scientific Sessions.
- Ms. Susan Randolph is serving her second term as a member of the NACOSH and was appointed Secretary of the Scientific Committee on OHN, which is one of the ICOH Scientific Committees.
- Dr. Rogers was recently appointed to the Board of Scientific Counselors (BSC) by the **Health** and **Human Services Secretary** Kathleen Sebelius and appointed Chair of the Board by Dr. John Howard.
- Faculty published 2 books, 12 book chapters, more than 40 articles in peer-reviewed journals, made more than 275 presentations, served as consultants to UNC, Oncology Services and ExxonMobil, chair/co-chairs/boards in ICOH, AOEC, AALNC, NEETF, NACOSH, NORA Sector Council, NC Ergonomics Research Center, served on numerous committees, AAOHN Foundation, and editor-in-chief for the *Journal of Legal Nurse Consulting*.
- Faculty teach in continuing education courses throughout the year. A total of 672 OHNs attended.
- All ERC students are required to attend the quarterly NORA Interdisciplinary Seminars during the year, as well as an initial orientation session that provides an overview of the NC OSHERC and its mission. As of 2005, the seminars are also webcast so OHN DE students, students from the safety and ergonomics program (North Carolina State University) and occupational

medicine residents (Duke University), and others are able to attend and participate. Examples of topics include: "Obesity in the Workplace," "Investigation of Dermal and Inhalation Exposure to Diisocyanates," "Occupational Health and Safety in a Globalized World," "Ergonomics Research and Practice to Promote Safety and Health in Mining" "The Future of Work". Continuing education programs are developed and CEU's are available to those who request them through UNC. Effective August 2009, certification maintenance (CM) points approved by the American Board of Industrial Hygiene have been available. This meets an identified need of certified CIHs, who can now obtain CM credits via the webcasts.

- OHN faculty and epidemiologist from the NC SHD are collaborating on a CDC research project: Respiratory Protection for Health Care Workers.
- From a literature review, information from accrediting bodies, and OHN standards and scope of practice a competency matrix was developed for achievement by students. This document is used to guide students through the curriculum of study, comprehensive examination, and master's paper.
- UNC's OHN Program and NCSU's Safety and Ergonomic faculty and students collaborated on a RWJ Grant related to MSD exposures in RN's at five NC hospitals.

Suggested MPH Program of Study by Learning Option, Fall Admission

Learning Option	Year	Fall Semester	Spring Semester	Summer Session
On Campus (full-time)	1	PHNU 781 & ENVR 432 PUBH 748 & PHNU 787 *PHNU 783	BIOS 600 & ENVR 423 PUBH 785 *PHNU 784	EPID 600 & HPM 600 Work on certifications Master's paper outline
	2	PHNU 782 & PUBH 746 PHNU 886	HBEH 600 & ENVR 600 Comprehensive exam	PUBH 992
Distance Education (part-time)	1	**PHNU 781 & ENVR 432**	ENVR 600 & ENVR 423	EPID 600; work on certifications
	2	PHNU 782 & PHNU 787	BIOS 600	HPM 600; work on certifications
	3	PUBH 746 & PUBH 748	HBHE 600 & PUBH 785 Master paper outline; Comprehensive exam	PHNU 886; CITI
	4	PUBH 992		

*PHNU 783 and/or PHNU 784 are needed if student has no or limited OHN experience.

Trainees and Program Graduates, Mentors, Research Summaries, and Publications

The table provides a list of all 28 research trainees supported during the 5 year period covered (2006-2011) with the preceptor or mentor indicated in parentheses and research topics identified:

Trainees' Name	Preceptor/ Mentor	Research Summary	Publications
Kristin Steihl	(J. Ostendorf)	Lit. review about Depression Management & the role of the OEHN	Rogers, B. **Stiehl, K**., Borst, J., Hutchins, S. & Hess, A. (2007). Heat related illnesses: Role of the occupational and environmental health nurse. *AAOHN Journal*, 55(7), 279-287.
Jill Connell	(S. Randolph)	Occ-Related Cardiovascular Injuries in Firefighters	
Debbie Fuldner	(J. Ostendorf)	Avian Influenza: A Potential Pandemic	
Diane Layne	(B. Rogers)	Gender Diff in Long Haul Trucking Industry Rel to Wrkr Hlth Perception-A Pilot Study	**Layne, D.,** Rogers, B., & Randolph, S.A. (2009). Health and gender comparisons in the long-haul trucking industry: A pilot study. *AAOHN Journal*, 57(10), 405-413.
Jennnifer Borst Best	(S. Randolph)	Violence in the Wrkplace: Impact on wrkers & Ers: the Role of the OEHN	Rogers, B. Stiehl, K., **Borst, J**., Hutchins, S. & Hess, A. (2007). Heat related illnesses: Role of the occupational and environmental health nurse. *AAOHN Journal*, 55(7), 279-287.
Lisa Bull	(B. Rogers)	The Aging Workforce: Implications for the OEHN	
Kathy Dayvault	(S. Randolph)	Obesity in the Workplace: Role of the OEHN	
Laurel Meadows	(J. Ostendorf)	Develop. & Eval. of the Case Mgmnt Program	
Shawna Hutchins	(S. Randolph)	Preventing Occupational Fatalities in Firefighters	Rogers, B. Stiehl, K., Borst, J., **Hutchins, S**. & Hess, A. (2007). Heat related illnesses: Role of the occupational and environmental health nurse. *AAOHN Journal*, 55(7), 279-287.
Shelly Johnson	(J. Ostendorf)	Hispanic Safety at Work	**Johnson, S**. & Ostendorf, J. (2009). "Hispanic employees in the workplace: Higher rates of fatalities. *AAOHN Journal*, 58(1), 11-16.
Lena Kalemba	(S. Randolph)	Telecommuting: Implications for the OEHN	
Larry Lee	(S. Randolph)	TBD	
Janice Ryckeley	(J. Ostendorf)	Response Model to Anthrax Exposure	
Katie Slavin	(B. Rogers)	Evaluation of the NEEF	Rogers, B. McCurdy, L., Roberts, J., **Slavin, K.** Grubb, K. (2008).

			Children's health faculty champions initiative. Environmental Health Perspective. Available online 12/08. Rogers, B., McCurdy, L., Roberts, J., & **Slavin, K**. (2008). Evaluation of the National Environmental Education Foundation children's environmental health faculty champions train-the-trainer workshop. *Environmental Health Perspective*.
Jason Tate	(J. Ostendorf)	Effects of Stretch Prog. on MSDs Inj.	
Henry Guevara	(J. Ostendorf)	Hispanic Participation in Cancer Support Grps: The Role of the OEHN	Im, E. O., Chee, W., **Guevara, E**., Liu, Y., Lim, H. J., Tsai, H., Clark, M., Bender, M., Kim, K. S., Kim, Y. H., & Shin, H. (2009). Gender and Ethnic Differences in Cancer Pain Experience: A Multiethnic Survey in the U.S. *Nursing Research, 56*(5), 296-306. Im, E.O., Chee, W., Tsai, H., Lim, H., **Guevara, E.,** Liu, Y. (2010). Evaluation criteria for Internet cancer support groups. *Computers, Informatics, Nursing, 28*(3), 183-188. Im, E.O., Lee, S.H., Liu, Y., Lim, H., **Guevara, E.**, Chee, W. A. (2009). National online forum on ethnic differences in cancer pain experience. *Nursing Research, 58*(2), 86-94. Im, E.O., Chee, W., Liu, Y., Lim, H.J., **Guevara, E.**, Tsai, H., Clark, M., Bender, M., Shin, H., Kim, K.S. & Kim, Y.H. (2007). Characteristics of cancer patients in Internet cancer support groups. *CIN: Computers, Informatics, Nursing, 25*(6), 334-343. Im, E., Chee, W., **Guevara, E**., Liu, Y., Lim, H., Tsai, H. (2007). Gender and ethnicity: are they influencing cancer pain? Abstract. *Oncology Nursing Forum, 34,* 2, 479. **Guevara, E**., Im, E., Chee, W. (2007). An exploration of how contextual factors influence the Hispanic cancer patients' attitudes toward Internet cancer support groups (ICSGs). Abstract. *Oncology Nursing Forum, 34,* 2, 480. Im, E. O., **Guevara, E**., & Chee, W. (2007). The pain experience of Hispanic patients with cancer in the United States. *Oncology Nursing Forum*, *34,* 2, 861-868. Im, E.O., Chee, W., Lim, H., Liu, Y., **Guevara, E**., Kim, K.S. (2007). Patients' attitudes toward Internet cancer support groups. *Oncology Nursing Forum, 34,*

			3, 705-712..
Sheryl McCall	(S. Randolph)	TBD	
Karen Siemering	(J. Ostendorf)	TBD	Rogers, B., Marshall, J., Garth, K., Mopkins, D., Remington, J., **Siemering, K**., Spivey, J. Focus on the Aging. *AAOHN Journal* (In Press).
Kenneth Uedoi	(B. Rogers)	TBD	Rogers, B., Dennison, K., Adejou, N., Dowd, S., **Uedoi, K**. (2010). Part 1: Vaccine cold chain: Proper handling and storage of vaccine. *AAOHN Journal,* 58(8), 337-344, Rogers, B., Dennison, K., Adejou, N., Dowd, S., **Uedoi, K**. (2010). Vaccine cold chain: Part 2: Training personnel and program management. *AAOHN Journal*, 58(9), 391-401.
Shelia Dowd	(S. Randolph)	TBD	Rogers, B., Dennison, K., Adejou, N., **Dowd, S**., Uedoi, K. (2010). Part 1: Vaccine cold chain: Proper handling and storage of vaccine. *AAOHN Journal*, 58(8) 337-344. Rogers, B., Dennison, K., Adejou, N., **Dowd, S**., Uedoi, K. (2010).Vaccine cold chain: Part 2: Training personnel and program management. AAOHN Journal, 58(9), 391-401.
Laurie Heagy	(J. Ostendorf)	TBD	
Jill Marshall	(S. Randolph)	TBD	Rogers, B., **Marshall, J**., Garth, K., Mopkins, D., Remington, J., Siemering, K., Spivey, J. Focus on the Aging. *AAOHN Journal* (In Press).
Kerry Garth	(B. Rogers)	TBD	Rogers, B., Marshall, J., **Garth, K**., Mopkins, D., Remington, J., Siemering, K., Spivey, J. Focus on the Aging. *AAOHN Journal* (In Press).
Dawn Mopkins	(S. Randolph)	TBD	Rogers, B., Marshall, J., Garth, K., **Mopkins, D**., Remington, J., Siemering, K., Spivey, J. Focus on the Aging. *AAOHN Journal* (In Press).
James Remington	(J. Ostendorf)	TBD	Rogers, B., Marshall, J., Garth, K., Mopkins, D., **Remington, J**., Siemering, K., Spivey, J. Focus on the Aging. *AAOHN Journal* (In Press).
Jody Spivey	(J. Ostendorf)	TBD	Rogers, B., Marshall, J., Garth, K., Mopkins, D., Remington, J., Siemering, K., **Spivey, J**. Focus on the Aging. *AAOHN Journal* (In Press).
Kim Dennison	(B. Rogers)	TBD	Rogers, B., **Dennison, K**., Adejou, N., Dowd, S., Uedoi, K. Part 1: Vaccine cold chain: Proper handling and storage of vaccine. *AAOHN Journal,* 58(8) 337-344, 2010. Rogers, B., **Dennison, K**., Adejou, N., Dowd, S., Uedoi, K. Vaccine cold chain: Part 2: Training personnel and

			program management. *AAOHN Journal*, 58(9), 391-401, 2010.
Saundra Trouslot	(K. Buckheit)	TBD	

Involvement of OHN Program Graduates in Research

One of current students who will graduate in May has just accepted a position as the occupational health nurse at the University of Texas in Austin and as part of his job he will be working with the IACUC (Institutional Animal and Use Committee) performing protocol review for any occupational health needs such as vaccinations for the researchers working with the human cell lines-Hepatitis B immunizations, etc. He plans to continue his research about Hispanics and cancer support groups and disseminate the information. Amy Pearson MPH, COHN-S, (MPH graduate, 2000) Director of Occupational Health Services at Pitt Memorial Medical Center in Greenville NC collaborates in research activities with Stephen Randall, hospital ergonomist in ergonomics and MSDs. She also is participating in Dr. Rogers' PERPP.

OHN Program Graduates Recent Publications

- Kathy Dayvault, MPH, COHN-S/CM (Graduate, 2009) published "The value of worksite wellness: Improving health while increasing a return on investment", Pure Safety Website: retrieved May 11, 2011 from http://info.puresafety.com/index.php/email/emailWebview?mkt_tok=3RkMMJWWfF9wsRonvavJZKXonjHpfsX66%2BQsXaWg38431UFwdcjKPmjr1YoFSNQhcOuuEwcWGog80BlKH%2FOUeoVU4w%3D%3D

- Katie Slavin, MS (Graduate, 2007) will be graduating in May 2011 with her DNP. Ms. Slavin has published four articles:

  Slavin, K. (2008). American Nurses Association's best practices in seasonal influenza immunization campaign. *AAOHN Journal*, 56(3), 123-128;

  Slavin, K. (2008). Environment, health, and safety: Health at every size. *American Nurse Today*, 3(1), 24;

  Slavin, K. (2008). Environment, health, and safety: Pediatric lead exposure. *American Nurse Today*, 3(3); and

  Slavin, K., (2008). Environment, health, and safety: Nanotechnology and the environment. *American Nurse Today*, 7(33).

- Olga Tompkins, MPH, COHN-S/SM. FAAOHN (Graduate, 2003) has published more than 30 articles in the Health Updates Section of the *AAOHN Journal.* Examples of topics include strange bedfellows, ears and air travel, traumatic incidents and emotional health, health risks among high-mobility families, business traveler fitness, and tuberculosis testing update.

- Amy Pearson MPH, COHN-S,(Graduate, 2000) Director of Occupational Health Services at Pitt Memorial Medical Center in Greenville NC, co-authored an article with Stephen Randall, Ergonomist for the Pitt Memorial Hospital, titled Expanded Occupational Safety and Health Administration 300 Log as metric for bariatric patient-handling staff injuries in *Surgery for Obesity and Related Diseases* (2009), 463-468.

Specific Effects of This Training Program on Curriculum and/or Research Directions

This training program has demonstrated several specific effects on the OHN Program curriculum. Based on contemporary knowledge of trends and input from trainees, topics added to the curriculum include the business context for occupational safety and health, mental health, case management, cost-benefit/effectiveness analysis, and demographic trend influences (e.g., aging, diversity). Because of increased emphasis on interdisciplinary training and education, we developed PUBH 785 Interdisciplinary Approaches in Occupation Health which is attended by all NIOSH trainees and others interested. The course is coordinated by OHN and taught by an interdisciplinary team including occupational medicine, industrial hygiene, safety and ergonomics, and epidemiology in occupational safety and health, and labor representatives.

Also implemented was a NORA-related interdisciplinary seminar now held four times per year. All ERC faculty have responsibility to develop the seminars, obtain speakers, etc. on a rotating schedule. As a part of the program of studies, Master's students are placed in practicum experiences throughout the nation with well qualified preceptors who respect the quality of the program and students. The practicum experience is a unique part of our program and students and preceptors alike believe it represents a learning opportunity for both parties. These experiences enable students to learn more about and apply advanced OHN skills. The OHN Program continues to attract excellent applicants from across the country. The OHN alumni tell us we are preparing them more than adequately. With expansion of our DE format, this, too, allows for an even wider array of students who bring a variety of experiences which increases the learning experience for all.

The importance of research activities continues to be stressed in the OHN Program. Faculty are engaged in the conduct of research, have obtained external funding for research support, and publish frequently. Students have the opportunity to participate in faculty-sponsored research and publish with faculty. For example, a collaborative research on MSDs of backs, upper, and lower extremities (NORA Priority) was conducted by Dr. Bonnie Rogers (PI), collaborating with Dr. Gary Mirka, director the NC State University Safety and Ergonomic Program, Ms. Judy Ostendorf, and Ms. Kathleen Buckheit, both OHN faculty with expertise in ergonomics. OHN and Safety and Ergonomic students participated in the research project. Publications are forthcoming. Currently, Dr. Rogers is conducting a study at 20 NC Hospitals related to respiratory protection. Ms. Buckheit and Dr. Edie Alfano-Sobsey, an epidemiologist with the NC DHHS are collaborating on Dr. Rogers' health care workers' PERPP.

As previously mentioned in this report, in 2011 a survey of our current students, academic graduates/alumni from 2005 to 2010 was conducted and found 100% are employed in occupational health or a like position. Five respondents have engaged in 10 research projects, 9 (90%) respondents had given more than 60 presentations, 7 respondents (53.8%) have published more than 50 articles, and 5 (38%) respondents had held elected positions or relevant leadership activities in professional societies. Many of the graduates have received promotions as a result of their education. For example, one was promoted to Corporate Health Services Manager with Progress Rail Services and another was promoted to Director of Employee Health Services at the University of New Mexico Hospital.

- When asked to give an example of how their training/education has impacted or improved OHS at work or reduced injuries and illnesses, or made life better for the employee one graduate responded, “By using effective case management, our company has lowered injury and illness rates by 70% in 2010 to 1.83 and decreased days away from work 96% over the previous year. Another commented, “Return to work strategies have helped me convince management the importance of keeping injured workers on the job”. A third graduated commented, “I have been able to enhance policy development in worksite programs. I now serve on the National Guard’s Occupational Health Advisory Council, which has allowed me to improve the National Guard’s programs through the 54 states and territories. The program has also increased my OHN knowledge and provides me with confidence to teach interdisciplinary courses; I have taught multiple safety courses and assisted with two CAOHC courses.”

Also many of our graduates have received awards and hold professional society elected offices such as

- selected as an AAOHN Fellow (2);
- serves as chair of the American Board of Occupational Health Nurses (ABOHN);
- elected to the Board of Directors (Director of Awards, Scholarship & Media) for the Illinois State AOHN;
- elected as 2nd Vice President and Program Chair for the NC Foothills AOHN

How Funds Provided Under Training Related Expenses Benefit the Program

The OHN program benefits from the training-related expense funding by providing partial salary support and faculty and trainee travel to attend professional association meetings or development opportunities. It is also used for all recruitment activities, OHN Advisory Board support, and for master’s students’ clinical placement site visits. Travel is also provided to attend the ERC Nursing Program Directors’ meeting. It provides infrastructure support in the form of partial program assistant support, library resources, office supplies, duplicating services, grant preparation materials, literature research charges, and development, printing, mailing, compilation and assessment of evaluation surveys, and communications. Because of the NIOSH support, we have been able to expand our curriculum to offer courses in a distance learning format, provide continuing education to the larger community, increase interdisciplinary interactions, provide the NORA interdisciplinary seminar series, and provide service to the professional community.

OCCUPATIONAL MEDICINE REPORT

The period covered by this report is 7/1/2007-6/30/2012.

The Duke OMR program currently has two residents enrolled in the residency. Over the last reporting period the program graduated 10 residents, all of whom have been supported with NIOSH training grants. This funding is essential to maintaining a quality program. The program was recently evaluated by the ACGME and received the maximum 5 year certification April 15, 2010. The Review Committee commended the program for its “demonstrated substantial compliance with the Accreditation Council for Graduate Medical Education (ACGME)

Requirements for Graduate Medical Education without citations." The Review Committee noted the following strengths or areas of substantial improvement since the last review: "Residents identified such strengths as faculty's willingness to work the residents' existing skills into the program and improve those skills, the balance between scholarship and clinical experience, faculty involvement in clinical care, and the interpersonal relationships between faculty and residents inherent in a small program. Faculty identified strengths as the range of opportunities available for residents, stable and compatible faculty group, and the commitment of the faculty to the residents' education."

The OMR program leadership including the program director, assistant director and RAC chairman has been stable over the last 5 years. There are no anticipated changes for the next 5-year funding cycle. The faculty and institutional support remains high. With the expansion of the Duke Epidemiology research program faculty (four fully grant supported PhD faculty) under the leadership of Dr. Dement, enhanced opportunities for resident trainees are now available in addition to the wealth of research opportunities at the UNC School of public Health. This activity is reflected in the significant federal funding that has been secured for occupational health research by Duke Faculty. Duke faculty and residents have been productive in the scholarly arena with over 100 publications and meeting presentations including collaborative efforts with other OMR faculty and faculty from the NC OSHERC in Epidemiology, Occupational Health Nursing, and Safety and Ergonomics. These publications are detailed in the yearly NIOSH Progress Reports and in the faculty biosketches.

The OMR curriculum has been enhanced with the addition of a more comprehensive two week long GME and OMR orientation program for new residents. Over the last project period the addition of the Duke Faculty led didactic curriculum, enhanced journal club, and seminar series have filled gaps in the academic MPH program at UNC. Interdisciplinary courses currently offered at the UNC School of Public Health as well as the NORA series also enrich the academic experience. A number of practicum sites have been added over the last project period to enhance hands on learning in corporate medicine, clinical practice, government, and labor.

Typical OM Resident MPH Curriculum

Fall

BIOS 600 Principles of Statistical Inference	3
EPID 600 Principles of Epidemiology	3
ENVR 600 Environmental Health	3
HBEH 600 Social and Behavioral Science in Public Health	3
PHNU 786 Occupational Safety and Ergonomics	3
PHNU 787 Fundamentals of Industrial Hygiene	2
ENVR 423 Industrial Medicine and Toxicology	3
Spring	
PUBH 735 Policy Development	3
PUBH 784 Project Management Strategy and Application	3
PUBH 731 Social Marketing	3
HPM 600 Intro to Health Policy and Administration	3
PUBH 790 Leadership Workshop.	2

PUBH 785 Interdisciplinary Approaches to Occupational Health	3
Summer	
PUBH 866 Field Practice in Public Health	3
Fall	
HPM 420 Community And Public Health Security	3
PUBH 791 Core Principles in Leadership	2
PUBH 992 Master's Paper	3

*Comprehensive examinations and a Masters Project are required before graduation.

The training program evaluation process has been greatly enhanced by implementing recommendations of the ACGME. The program director, Dr. Darcey, is now heavily engaged in incorporating new ACGME curriculum requirements that begin in this year's training cycle. The program director also receives guidance from the Duke Graduate Medical Office, the Department Educational Task Force, the RAC and the national residency directors. Some of the innovations resulting from these recommendations include the addition of detailed ACGME learning objectives that are cross referenced in a matrix to ensure residents are accomplishing these objectives in both the academic and practicum years. The Duke matrix is highlighted as a best practice on the ACGME Preventive Medicine web site: http://www.acgme.org/acWebsite/notablepractices/default.asp?SpecID=84

Outreach activities to translate research and education into the practitioner environment have been very successful for workers in the construction, health care, and cobalt production industries. Continuing education activities are provided in a number of venues including the internet with over 3,000 occupational health professionals around the globe enrolled in a daily forum discussing new and evolving occupational health issues and concerns. Over the project period continuing educational offerings have been provided to over 10,000 occupational health professionals in medicine, nursing, industrial hygiene, and safety. Additional medical school courses have been added to serve both Duke and UNC medical students and residents.

The OMR program continues to attract excellent candidates for training and has been fortunate to enroll a high percentage of minority trainees. A summary of the portfolio for OMR trainees over the last training cycle is included in Table D.

Current Residents:

Table D

Summary of OMR Trainees Last Training Cycle

1. Thomas Bender, MD, PhD

Dates of Duke OMR Training: July 1, 2011 – June 2013

Degrees: BS, Chemistry/Biology, Duke University, 1996**;** MSPH, Public Health, University of Alabama Birmingham, 2001**;** PhD, Epidemiology, University of Alabama Birmingham, 2005**;** MD, NIH Medical Scientist Program, University of Alabama Birmingham, 2006

Residency Training: Internal Medicine, University of Tennessee Knoxville, 2008-2009**;** CDC Epidemic Intelligence Service, 2009-2011

NIOSH Support: Yes

Doctorate Paper: "Cancer Incidence among Semiconductor and Storage Device Manufacturing Workers"

Publications / Scholarly Work:

1. Lipworth L, **Bender TJ**, Rossi M, Bosetti C, Negri E, Talamini R, Giacosa A, Franceschi S, McLaughlin JK, La Vecchia C. Dietary vitamin D intake and cancers of the colon and rectum: a case-control study in Italy. Nutr Cancer 61(1):70-75, 2009.
2. **Bender TJ**, Beall C, Cheng H, Herrick RF, Kahn AR, Matthews R, Sathiakumar N, Schymura MJ, Stewart JH, Delzell E. Cancer incidence among semiconductor and electronic storage device workers. Occup Environ Med 64(1):30-36, 2007.Beall C,
3. **Bender TJ**, Cheng H, Herrick R, Kahn A, Matthews R, Sathiakumar N, Schymura M, Stewart J, Delzell E. Mortality among semiconductor and storage device-manufacturing workers. J Occup Environ Med 47(10):996-1014, 2005.Herrick RF,
4. Stewart JH, Blicharz D, Beall C, **Bender T**, Cheng H, Matthews R, Sathiakumar N, Delzell E. Exposure assessment for retrospective follow-up studies of semiconductor- and storage device-manufacturing workers. J Occup Environ Med 47(10):983-985, 2005. B**ender TJ**, Beall C, Cheng H, Herrick RF, Kahn AR,
5. Matthews R, Sathiakumar N, Schymura MJ, Stewart JH, Delzell E. Methodologic issues in follow-up studies of cancer incidence among occupational groups in the United States. Ann Epidemiol 16(3):179-179, 2005. Kaslow RA, Rivers C, Tang J,
6. **Bender TJ**, Goepfert PA, El Habib R, Weinhold K, Mulligan MJ; NIAID AIDS vaccine evaluation group. Polymorphisms in HLA class I genes associated with both favorable prognosis of human immunodefieicney virus (HIV) type 1 infection and positive cytotoxic T-lymphocyte responses to ALV AC-HIV recombinant canarypox vaccines. J Virol 75(18):8681-8689, 2001.

2. Cynthia Feltner, MD, MPH

Dates of Duke OMR Training: July 1, 2010 – June 2012

Degrees: BS, Biology, University of Richmond, 1998; MD, Medicine, University of West Virginia, 2002

Residency Training: Internal Medicine, Duke University Hospital, 2003-2006 (board certified)

NIOSH Support: Yes

Master's Paper:" Does Participation in a Workplace Physical Fitness Program decrease rates of musculoskeletal injuries?"

Publications / Scholarly Work: anticipate master's project will lead to publication

1. Caveney, BJ and **Feltner**, C. 2011 Revision Author for Chapter 46: Blood bore Pathogens in the Workplace, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2011 (in press).

2. **Feltner**, C. 2011 Revision Author for Chapter 38: Heart Disease, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2011 (in press).

3. Diane Ballerino-Regan, MD, MPH, MS

Dates of Duke OMR Training: July 1, 2009 - December 31, 2010

Degrees: BA, Psychology, Scripps College, 1979; MD, Medicine, Universidad Autonoma de Guadalajara, 1985; MS, Gerontology, University of California Los Angelos, 1981; MPH, Occupational and Environmental Health, San Diego State University, 2009

Residency Training: Internal Medicine, New York Downtown Hospital, 1987-1989 **;** OBGYN, Nassau University Medical Center, 1989-1991**;** OBGYN, Florida State Sacred Heart Hospital, 1991-1994

NIOSH Support: Yes

Masters Project: "Pre-term Delivery in Tijuana's Working Women Associated Risk Factors a Case Control Study"

Publications/Scholarly Work:

1. **Ballerino-Regan, D**. and Longmire, A.W. Letter to the Editor – Hydrogen Sulfide. Arch Pathol Lab Med. 2010 Aug;134(8):1105. PMID: 20670127.
2. **Ballerino-Regan D**, 2010 Revision Author for Chapter 41: Reproductive Disorders and Birth Defects, *in* Occupational Injuries and Illnesses, Brian J. Caveney, *ed*. Lexis-Nexis. 2010.
3. **Ballerino-Regan, D**. The Medical Side of Reproductive Counseling: After the Teratology Consult for the Pregnant Worker. Presentation at the 2010 Organization of Teratology Information Specialists (OTIS) 23d. Annual Meeting, June29, 2010.
4. **Ballerino-Regan, D**. Pre-term Delivery in Tijuana's Working Women Associated Risk Factors a Case Control Study. Presentation at the 2010 American Occupational Health Conference (AOHC-2010) Session 2204 - Current Research in OEM and Resident Research Session. Session Presented on 05/03/2010.
5. **Ballerino-Regan D,** Cortez D, Rundman S, Morales E, Turek D, Loftus A, Fagan K. Enhancing Worker Advocacy: OSHA's Outreach to Diverse Worker Populations Poster Presentation Presented at the 1st. National Action Summit for Latino Worker Health and Safety, Houston TX 04/14/2010.
6. **Ballerino-Regan D**, Cortez D, Rundman S, Morales E, Turek D, Loftus A, Fagan K. Enhancing Worker Advocacy: OSHA's Outreach to Diverse Worker Populations. Poster and Discussion Session - Strengthening Environmental Justice Research and Decision Making: A Symposium on the Science of Disproportionate Environmental Impacts. Sponsored by US EPA. Washington, DC, 03/18/2010.
7. **Ballerino-Regan D**, Kucera K. NORA Pilot Project: Working Restrictions among Duke University Employees during Pregnancy. NCOSHERC, 2011.

4. Qilin Song, MD, PhD

Dates of Duke OMR Training: July 1, 2010 – June 2011

Degrees: MD, Harbin Medical University, China, 1989; MPH, Preventive Medicine, Harbin Medical University, China, 1991; MS, Epidemiology, Harbin Medical University, China, 1994; PhD, Epidemiology, Harbin Medical University, China, 1997; MPH, Preventive Medicine, Meharry Medical College, 2009

Residency Training: Preventive Medicine, Meharry Medical College, 2009 (board certified)

NIOSH Support: Yes

Master's Doctorate Paper: "Risk factors for Syphilis and Sexually Transmitted Diseases Among Female Sex Workers in Seven Provinces in China"

Post Graduate Employment: Medical Director, Metropolitan Community Health Services, Washington, NC

Publications / Scholarly Work:

1. **Song Q**, "Risk Factors for Syphilis and Sexually Transmitted Infections among Female Sex Workers in Seven Provinces of China "(Abstract 800301 - Poster P-041). ACOEM 2010 AOHC Conference, Orlando, FL.
2. **Song Q**, "HIV/AIDS Knowledge, HIV-Risk Related Behaviors and Availability of HIV-Related Health Services Among Female Sex Workers in Seven Provinces of China" (Abstract 803832- Poster P-042). ACOEM 2010 AOHC Conference, Orlando, FL.
3. **Song Q**, "Predicting Infant Mortality Rates in Mississippi Based on Grey Models" Song Q, ATSDR and TN State Department of Public Health Poster Session, 2008 APHA Meeting.
4. **Song Q**, "Determinants of mortalities and morbidities of cardiovascular diseases in United States." ATSDR and TN State Department of Public Health Poster Session, 2008 APHA Meeting.

5. Anand Joshi, MD, MHA

Dates of Duke OMR Training: January 2008 – June 2009

Degrees: BS, Kent State University, 2002; MD, Northeastern Ohio University Medicine, 2003; MHA, University of North Carolina School of Public Health, 2008

Residency Training: Internship, Aultman Hospital, 2004**;** Resident, Physical and Rehabilitation, East Carolina University, 2004-2007; Fellowship, Spine Center, University of Pennsylvania, 2009-2010

NIOSH Support: Yes

Master' Paper: "Business and Marketing Plan for the Duke Spine Center"

Post Graduate Employment: Assistant Clinical Professor, Duke Spine Clinic, Durham, NC

Publications / Scholarly Work:

1. **Anand B. Joshi**, Chapter 14: Fractures and Dislocations of the Cervical Spine, *in* Occupational Injuries and Illnesses, Brian J. Caveney, *ed*. Lexis-Nexis. 2010.
2. **Anand B. Joshi**, Chapter 14A: Injuries of the Thoracic Spine, *in* Occupational Injuries and Illnesses, Brian J. Caveney, *ed*. Lexis-Nexis. 2010.
3. **Anand B. Joshi**. Chapter 15: Low Back Injuries, *in* Occupational Injuries and Illnesses, Brian J. Caveney, *ed*. Lexis-Nexis. 2011 (in press).
4. Plastaras CT, **Joshi AB**. The Electro diagnostic Evaluation of Radiculopathy. PM R Clin of NA. 22(1): 59-74
5. Plastaras CT, **Joshi AB**. The Electrodiagnostic Evaluation of Neck Pain. PM R Clin of NA. In Press

6. Vipul Shah, MD, MPH

Dates of Duke OMR Training: August 2008 – June 2009

Degrees: Medical College of Vadodara, Baroda, India, 1999

Residency Training: Internship, Medical College of Vadodara, Baroda, India, 2000-2001**;** Resident, Industrial Health, Department of Preventive and Social Medicine, Medical College of Vadodara, Baroda, India 2001-2003; Internal Medicine, University of Pittsburg Mercy Hospital, 2005-2008

NIOSH Support: Yes

Master' Paper: "Cobalt Development Institute Global Exposure and Medical Surveillance Survey"

Post Graduate Employment: Attending Physician Alamance County Medical Center, Burlington, NC

Publications / Scholarly Work:

1. **Shah V**, "Ocular, Musculoskeletal and Ergonomic manifestations among computer professionals in India," Invited Speaker, Applied Ergonomics Conference and Expo 2009, Reno, NV
2. **Shah V**, "Ocular, Musculoskeletal and Ergonomic manifestations among computer professional in India" – Poster presentation at the 2009 AOHC / ACOEM annual conference, San Diego, CA.
3. **Shah V**, "Practicing Occupational Medicine in USA," Invited Speaker, Basic Concepts in Occupational

and Environmental Medicine 2009, New Delhi, India

7. John Longphre, MD, MPH

Dates of Duke OMR Training: August 2006 – July 2008

Degrees:BS, Biochemistry, North Carolina State University, 1999 **;** MD, Medicine, University of North Carolina, 2003

Residency Training: General Surgery, University of North Carolina Hospital, 2003-2004**;** Hyperbaric Medicine, Duke
University Hospital, 2004-2005

NIOSH Support: Yes

Master' Paper: "The science and economics behind the practice of Critical Care Hyperbaric Medicine". "Breast Cancer and the Environment."

Post Graduate Employment: Associate Medical Director Work Care, Greensboro, NC

Publications / Scholarly Work:

1. Moon R, **Longphre, JP**.Textbook Chapter: *Hyperbaric Medicine Chapter*, Civetta, Taylor, & Kirby's Critical Care 4th Ed. 2009.
2. **JM Longphre,** DJ Darcey. Interesting Case of Lead-poisoning in a Police Officer, Poster Presentation: American College of Occupational Medicine 2008 AOHC Annual Meeting, New York, NY.
3. Cherry AD, Forkner IF, Frederick HJ, Natoli MJ, Schinazi EA, Conard JL, **Longphre JP**, White W, Frieberger JJ, Stolp BW, Pollock N, Doar PO, Boso AE, Alford EL, Walker AJ, Ma A, Rhodes MA, Moon RE. *Predictors of Increased PaCO2 during Immersed Prone Exercise at 4.7 ATA*. Journal of Applied Physiology. September 2008.
4. Pollock NW, Cherry AD, Forkner IF, Natoli MJ, Frieberger JJ, Stolp BW, **Longphre JP**, Conard JL, Rhodes MA, Schinazi EA, Doar PO, Boso AE, Alford EL, Walker AJ, Frederick HJ, Moon RE.Comparison of end-tidal versus arterial measures of CO_2 during immersed exercise at surface and depth. Undersea and Hyperbaric Medical Society (UHMS) Annual Meeting, 2007
5. **Longphre JP**, Denoble PJ, Moon RE, Vann RD, Freiberger JJ. First aid normobaric oxygen for the treatment of recreational diving injuries. Undersea Hyperb Med. 2007; 34(1): 43-49.
6. Moon RE, Forkner IF, Pollock NW, Freiberger JJ, Stolp BW, **Longphre JP**, Conard JL, Natoli MJ, Schina. **The effect of static lung load on hemodynamics and gas exchange during prone immersed exercise.** Undersea Hyperb Med. 2007; 34(4): 289.
7. Cherry AD, Forkner IF, Pollock NW, Freiberger JJ, Stolp BW, **Longphre JP**, Conard JL, Ma AC, Rhodes MA. **Effect of increased respiratory resistance on carbon dioxide levels and hemodynamics in the submerge.** Undersea Hyperb Med. 2007; 34(4): 288.
8. Pollock NW, Cherry AD, Forkner IF, Natoli MJ, Freiberger JJ, Stolp BW, **Longphre JP**, Conard JL, Rhode. **Comparison of end-tidal versus arterial measures of carbon dioxide during immersed exercise at surfa.** Undersea Hyperb Med. 2007; 34(4): 288-289.
9. **Longphre JP**, Denoble PJ, Moon RE, Vann RD, Freiberger JJ. **First aid normobaric oxygen for the treatment of recreational diving injuries.** Undersea Hyperb Med. 2007; 34(1): 43-50.
10. Forkner IF, Pollock NW, Freiberger JJ, Stolp BW, **Longphre JP**, Conard JL, Natoli MJ, Schinazi EA, Doa. **Effect of inspired PO2 on hemodynamics and gas exchange during immersed exercise at 122 fsw.** Undersea Hyperb Med. 2006; 35(5): 364-365.
11. Moon RE, **Longphre JP**. Diving. In: Laurent GJ, Shapiro SD, eds. Encyclopedia of Respiratory Medicine. San Diego, CA: Academic Press; 2006: 21-29.
12. **Longphre JP**. First Aid Oxygen Update and the DAN® Oxygen Card, Alert Diver Magazine, Nov / Dec

2006.

13. **Longphre JP**, Freiberger JJ, Denoble PJ, Vann RD. Utility of first aid oxygen prior to recompression treatment for diving injuries. Undersea Hyperb Med. 2005; 32(4): 229.
14. **Longphre JP**. First Aid Surface Oxygen, Is it worth it? Alert Diver Magazine, July/August 2005.

8. Hassan Zakaria, MD, MPH

Dates of Duke OMR Training: July 2006 – June 2008

Degrees: BS, Environmental Science, University of Georgia, 1998**;** MD, Medicine, University f Georgia, 2003**;** MPH, Virginia Commonwealth University, 2006

Residency Training: Internal Medicine, Virginia Commonwealth University, 2003-2004

NIOSH Support: Yes

Master' Paper: "Analgesic Use in U.S. Emergency Departments for Patients Reporting Moderate to Severe Pain: Select Patient Characteristics Influencing Narcotic Analgesic Prescribing Practices."

Post Graduate Employment: Occupational Physician, Memorial Occupational Health Clinic, Colorado Springs, CO.

9. Marc-André R. Chimonas, MD, MPH

Dates of Duke OMR Training: July 2005-July 2007

Degrees:BA, Cornell University, 1995**;** MD, Medical College of Georgia, 2000**;** MPH, Loma Linda University School of Public Health, 2003

Residency Training: Preventive Medicine Residency, Loma Linda University, 2000-2003 ; CDC Epidemiologic Intelligence Service Physician, 2003-2005

NIOSH support: Yes

Master's Paper: "Airborne particulate matter from primarily geologic, non-industrial sources at levels below National Ambient Air Quality Standards is associated with outpatient visits for asthma and quick-relief medication prescriptions among children less than 20 years old enrolled in Medicaid in Anchorage, Alaska."

Post Graduate Employment: Occupational Medicine Physician, WorkWell, Fort Collins CO.

Publications / Scholarly Work:

1. Gessner BD, **Chimonas MA**, Grady SC. It takes a village: community education predicts paediatric lower-respiratory infection risk better than maternal education. J Epidemiol Community Health. 2010 Feb;64(2):130-5. Epub 2009 Aug 6.
2. **Chimonas MA**, Vaughan GH, Andre Z, Ames JT, Tarling GA, Beard S, Widdowson MA, Cramer E. Passenger behaviors associated with norovirus infection on board a cruise ship-Alaska, May to June 2004. J Travel Med. 2008 May-Jun;15(3):177-83.
3. Castrodale L, Gessner B, Hammitt L, **Chimonas MA**, Hennessy T. Invasive early-onset neonatal group B streptococcal cases--Alaska, 2000-2004. Matern Child Health J. 2007 Jan;11(1):91-5. Epub 2006 Dec 16.
4. **Chimonas MA**, Gessner BD. Airborne particulate matter from primarily geologic, non-industrial sources at levels below National Ambient Air Quality Standards is associated with outpatient visits for asthma and quick-relief medication prescriptions among children less than 20 years old enrolled in Medicaid in Anchorage, Alaska. Environ Res. 2007 Mar;103(3):397-404. Epub 2006 Oct 17.
5. Gessner BD, **Chimonas MA.** Asthma is associated with preterm birth but not with small for gestational age status among a population-based cohort of Medicaid-enrolled children <10 years of age. Thorax. 2007 Mar;62(3):231-6. Epub 2006 Oct 13.
6. **Chimonas MA**, Baggett HC, Parkinson AJ, Muth PT, Dunaway E, Gessner BD. Asymptomatic Helicobacter pylori infection and iron deficiency are not associated with decreased growth among

Alaska Native children aged 7-11 years. Helicobacter. 2006 Jun;11(3):159-67.

7. Arnold SM, Zarnke RL, Lynn TV, **Chimonas MA**, Frank A. Public health evaluation of cadmium concentrations in liver and kidney of moose (Alces alces) from four areas of Alaska. Sci Total Environ. 2006 Mar 15;357(1-3):103-11. http://www.ncbi.nlm.nih.gov/pubmed
8. Lead exposure from indoor firing ranges among students on shooting teams--Alaska, 2002-2004. Centers for Disease Control and Prevention (CDC). MMWR Morb Mortal Wkly Rep. 2005 Jun 17;54(23):577-9.

10. Amit R. Paliwal, MD, MPH, MBA

Dates of Duke OMR Training: August 2005- August 2007

Degrees: BA, University of California – Los Angeles, 1995**;** MD, American University of the Caribbean, 1998**;** MBA, University of La Verne, 2000**;** MPH, University of California – Los Angeles, 2003

Residency Training: Family Medicine, Arrowhead Regional Medical Center, CA, 2002-2005

NIOSH support: Yes

Post Graduate Employment: Private Practice, Family and Occupational Medicine, Pomona, CA.

OCCUPATIONAL SAFETY/ERGONOMICS REPORT

Period Covered by the Report: 7/1/2007 – 6/30/2012

During the current project period, 11 high quality students were recruited to the OSE training program, including 2 PhD and 9 master's students. At the present time, six of these students have graduated and the remaining five have matriculated. All of these students have been productive in terms of research participation and publications. (Selection of new students for traineeships starting in Fall 2011 is currently underway with consideration of those admitted to ISE Department degree programs.) In terms of curriculum development, while Dr. Hsiang was present in the department, two graduate elective courses were added to the catalog and Dr. Kaber developed an additional course in "Cognitive Engineering". In addition, several core course numbers were changed to more appropriately reflect level of study or difficulty. Despite attrition among the core faculty, including Dr. Mirka's move to Iowa State University and Dr. Hsiang's return to Texas Tech University, the OSE Program has continued to deliver all core courses along with some graduate electives through adjunct instructor support. With respect to program research developments, biomechanics and safety remained as core directions (with a particular focus on repetitive stress injury prevention) and new thrusts in cognitive systems engineering and human-computer interaction have developed. Research projects have focused on specific types of systems (aircraft, automobiles, etc.). Student participation all of these areas of research has been strong including two pilot projects through the ERC led by master's trainees. Related to this, until Dr. Hsiang's departure in Fall 2010, the ergonomics area maintained lab staffing and student counts comparable to those when Dr. Mirka was administering the program.

The safety and ergonomics training provided through our program comes from both required and elective courses. Students select from the courses (or equivalents) listed in **Table E**. (Required "safety concentration" courses for trainees appear in **bold**.)

Table E: Required and elective courses through OSE program.

ISE/PSY 540 (3 hrs.): Human Factors in Systems Design

ISE 541 (3 hrs.): Occupational Safety Engineering
ISE 544 (3 hrs.): Occupational Biomechanics
ISE 740 (3 hrs.): Engineering Psychology of Human-Computer Interaction
ISE 741 (3 hrs.): Systems Safety
ISE/PSY 743 (3 hrs.): Ergonomics Performance Assessment
ISE/PSY 744 (3 hrs.): Human Information Processing (or ISE/PSY 745 (3 hrs.): Human Performance Modeling)
ISE 794 (3 hrs.): Advanced Problems in Ergonomics
ISE 796 (3 hrs.): Research Practicum in Human Factors & Ergonomics
ISE 796A (3 hrs.): Cognitive Engineering
PUBH 785 (3 hrs.): Interdisciplinary Approaches in Occupational Health (offered at UNC-Chapel Hill (CH))

(NIOSH trainees must take at least one of the following elective courses as part of their degree program.)

ENVR 423 (3 hrs.): Industrial Medicine and Toxicology (offered at UNC-CH)
ENVR 433 (3 hrs.): Health Hazards of Industrial Operations (offered at UNC-CH)
MAE 510 (3 hrs.): Effects of Noise and Vibration
MAE 514 (3 hrs.): Industrial Noise Control
EPID 160 (3 hrs.): Principles of Epidemiology (offered at UNC-CH also online)
EPID 710 (4 hrs.): Fundamentals of Epidemiology (offered at UNC-CH)
EPID 780 (3 hrs.): Occupational Epidemiology (offered at UNC-CH)
PHNU 787 (2 hrs.): Fundamentals of Industrial Hygiene (online)

Prototypical program from master's students.

Semester 1 (9 hrs. towards degree; seminar credit does not apply):
ISE 514 Manufacturing Product Engineering (breadth)
ISE 540 Human Factors in Systems Design
ISE 544 Occupational Biomechanics
ISE 601 Industrial Engineering Seminar (1 hr.)
Semester 2 (9 hrs. towards degree; seminar credit does not apply):
ENVR 423 Industrial Medicine & Toxicology
ISE 541 Occupational Safety Engineering
ISE 601 Industrial Engineering Seminar (1 hr.)
ST 516 Experimental Statistics For Engineers II
Semester 3 (9-12 hrs. towards degree):
ISE 695 Master's Thesis Research (3-6 hrs.)
ISE 741 Systems Safety Engineering
ISE 762 Computer Simulation Techniques (breadth)
Semester 4 (9 hrs. towards degree):
ISE 744 Human Information Processing (or ISE 745 Human Performance Modeling)
ISE 796 Research Practicum in Human Factors & Ergonomics
PUBH 785 Interdisciplinary Approaches to Occupational Health
Total = 36-39 hrs.

Faculty Research and Publications

Three faculty contributed to OSE program research during the project period, including Drs. Hsiang, Kaber and Mirka. Statistics on grants, publications and participation in outreach are presented below:

Research and Continuing Education Contributions	**Count**
Number of basic research grants from Federal agencies (Hsiang = 1; Kaber = 9; Mirka = 2)	12
Number of NIOSH technical grants (in addition to ERC funding)	2
Total Federal funding (in addition to ERC)	~$3.25M
Number of archival journal publications (Hsiang = 11; Kaber = 18; Mirka = 27)	56
Number of outreach activities (also see outreach information section)	~50
Number of continuing education courses (also see outreach information section)	~6

Current Trainee Research and Publications

All NIOSH trainees have been involved in Ergonomics Laboratory research projects.

1. Michael Clamann (OSE PhD trainee; Advisor - Kaber)

Michael has participated in a NSF-sponsored research project aimed at designing VR-based simulations that integrate haptic control devices for motor rehabilitation and fine motor skill training. He conducted an experiment (in collaboration with Duke University faculty) to assess motor control limitations in non-dominant hand use when performing standard neuropsychological tests. Tests were conducted pre- and post-exposure to a rehabilitation therapy regimen involving a virtual block design task using a high fidelity, stylus-based haptic control. Future studies are to integrate fMRI (functional magnetic resonance image) screening of subjects for cerebral blood flow patterns to identify the impact of the VR-based therapy on brain and motor function recovery.

2. Will Heath (OSE MS trainee; Advisor - Hsiang)

Will has worked with Drs. Hsiang and Kaber to develop a research project on ladder safety, specifically slip-outs due to shallow setup angles. He has conducted a literature review revealing a need for additional knowledge on how individual characteristics and perceptual factors relate to selection of initial ladder setup angles. He planned to investigate the range of perceived acceptable setup angle using computer-based testing and observation of actual ladder setup angles in the laboratory. This research is expected to produce recommendations for construction worker training on ladder safety risks.

3. Meghan Rogers (OSE MS trainee; Advisor - Kaber)

Meghan received funding for a pilot research project through the NC OSHERC for, “A study of musculoskeletal disorders of veterinarians for large animals.” This research is a follow-on to a prior study of ergonomic risk factors in small animal veterinarian operations at a local veterinary clinic. The pilot project is to involve the NCSU College of Veterinary Medicine in: (1) a task analysis on large animal operations; (2) development of a taxonomy of musculoskeletal

disorders (MSDs) associated with such tasks; (3) identification of tasks posing high ergonomic risks based on subjective screening; (4) quantitative ergonomic analyses of high risk tasks; and (5) recommendation of ergonomic interventions to reduce the potential for MSDSs.

Publications to date:

Rogers, M., Gangakhedkar, S. & **Kaber**, D. B. (2011). Ergonomic evaluation of emergency veterinary clinic operations. In *Proceedings of the 2011 Applied Ergonomics Conference* (CD-ROM). Orlando, FL (March 21-23): IIE.

Rogers, M., Gangakhedkar, S., & **Kaber**, D. (2011). KEEPING Fido's helpers HEALTHY. Industrial Engineer: IE, 43(3), 26-31.

Rogers, M., **Heath**, W., **Uy**, C., Suresh, S., & **Kaber**, D. (in review). Effect of multiple displays on task performance in laparoscopic surgical procedures. Submitted to *Applied Ergonomics*.

Rogers, M., Zhang, Y., **Kaber**, D., Liang, Y., Gangakehedkar, S. (2011). The Effects of Visual and Cognitive Distraction on Driver Situation Awareness. In D. Harris (Ed.): *Engin. Psychol. and Cog. Ergonomics, HCII 2011* (pp. 186–195). Berlin Heidelberg: Springer-Verlag.

4. Kinley Taylor (OSE MS trainee; Advisor - Kaber)

Kinley has worked with Dr. Kaber to develop a research project focused on modeling risk factors to hygiene in healthcare operations. This is a collaborative effort between NCSU and Massachusetts General Hospital (MGH) to establish the frequency of staff exposures to hygiene hazards (sources of disease) during outpatient clinic operations and the severity of outcomes associated with specific exposures. A survey study is to be conducted to capture staff perceptions of hygiene hazards. Perceptions are to be compared with objective hazard exposure date in order to specify education and training needs.

5. Chad Uy (OSE MS trainee; Advisor - Hsiang)

Chad conducted an investigation of musculoskeletal loading of the upper-extremity in liquid pouring tasks with laundry detergent bottles having various handle designs. The study was conducted at the Liberty Mutual Research Center. Motion tracking was used as a basis for biomechanical analysis of forces and torques at upper-extremity joints and EMG to assess muscle activation levels. The ultimate objective of this research is to improve the ergonomics of bottle handle designs. Findings may benefit persons performing liquid pouring tasks many times a day using large bottles, such as chemicals in industry.

Past Trainee Research (Publications are in Publication section of report)

Trainee	**Advisor**	**Thesis**
Allison Anderson	Mirka	"Learning Curve Analysis for Alternative Keyboards"
Matt Diering	Kaber	"Ergonomic Evaluation of Scaffolding Task Interventions for Power Plant Maintenance"
Jonathan Drum	Mirka	"An Investigation of the Effects of Fatigue and Stance Width on Ground Reaction Forces and Trunk Kinematics"
Jacklyn Freeman	Mirka	"Evaluating the Effects of Age on the Variability in Lifting Technique"
Meghan Garner	Kaber	N/A (non-thesis master's)

Lashanda Hodge	Kaber	"Assessing interactive system effectiveness with usability design heuristics and Markov models of user behavior"
Leigh McClure	Mirka	"Effects of Time of Day and Warm-Up on Lifting Kinematics"
Kristen Meador	Mirka	"Ergonomic Interventions for an Ultrasound Transducer"
Stephanie Reid	Mirka	"Learning Curve Analysis of a Patient Lift Assist Device"
Stephanie Southard	Mirka	"Evaluating a New Design for the NASA SCAPE Harness"
Theo Veil	Kaber	N/A (non-thesis master's)

Journal Articles:

Program Effects on Curriculum and Research Direction

There have been several changes to the OSE program curriculum during the project period, including the addition of elective courses and course number revisions. When Dr. Hsiang joined the ISE Department, he developed two new classes including:

ISE 712 – Bayesian Decision Analysis for Ergonomics Applications - Description of dynamic mechanisms leading to complex decision making in working scenarios, leisure activities, interpersonal interaction, etc.

ISE 794D – Risk Analysis - Modeling human bias, efficiency, and sufficiency in probing (or information gathering) in complex decision processes.

In addition to these courses, in the Fall of 2008, Dr. Kaber introduced a new course:

ISE 794A – Cognitive Engineering – Exploration of cognitive engineering research through review of literature. Focus on approaches to measurement, modeling, and design of cognitive work. Formal presentations of articles and seminar discussions.

The course number revisions that occurred impacted Human Factors in Systems Design (from ISE 740 to 540) and Occupational Safety Engineering (from ISE 741 to 541). Both of these course represent introductory graduate-level courses in the various areas.

With respect to the research enterprise in our laboratory, the Center grant and training program have had four major impacts: (1) support for "unfunded" research projects of interest to faculty and students; (2) enhancement of effort on projects funded by other Federal agencies or industry; (3) student access to pilot project funding; and (4) generation of scholarly research products through the research practicum course (ISE 796). During the reporting period, the Ergonomics Lab identified two new research thrusts, including "human-robot interaction in healthcare applications" and "driver situation awareness and behavior." The College of Engineering provided start-up funds for research equipment to support these thrusts, including mobile robots and a full-scale driving simulator. Initial research projects using this equipment were unfunded and the Center grant allowed for staffing with NIOSH trainees. Many students within the lab expressed interests in the topic areas (e.g., Garner, Lee, Rogers, Taylor). Regarding enhancement of research effort on funded projects, several of the NIOSH trainees have expressed interest in participating on teams addressing NASA or NSF-funded research projects (e.g., Clamann). The Center grant has allowed the students to contribute to these efforts, gain experience in team research, and to identify novel thesis or dissertation

topics that are related to the sponsored work. The Center grant also provided master's and PhD student with access to pilot project grants. Two OSE trainees (Deiring, Rogers) received funding ($10K and $13K) for experimental studies that led to their thesis research projects. Finally, the Center funding has provided support for student effort on publications related to research practicum projects that extend beyond the requirement of the course (i.e., a single journal manuscript). This has served to increase lab publication productivity.

OCCUPATIONAL EXPOSURE SCIENCE/ INDUSTRIAL HYGEINE REPORT

The period covered by this report is 7/1/2007-6/30/2012.

This past funding cycle (7/1/2007 – 6/31/2012) the UNC-CH NIOSH ERC Industrial Hygiene Program was identified as Exposure Assessment and Control (EAC) focus group, which included industrial hygiene (IH), exposure assessment, and air pollution control. The faculty formed a strong and broad exposure assessment group, which provided unique and innovative methods and state-of-the-art statistical knowledge and tools to evaluate exposures. We provided our NIOSH IH trainees and other EAC students broad academic and research experience (Table F) in conducting filed studies to (1) develop exposure assessment methodologies, (2) investigate exposure-dose-response relationships, and (3) calibrate models for the optimal control of exposure. Furthermore, the EAC had an important link to the Epidemiology and Biostatistics departments, which provide the knowledge base needed to investigate the level of risk associated with a given exposure and how the control of such risk can be achieved.

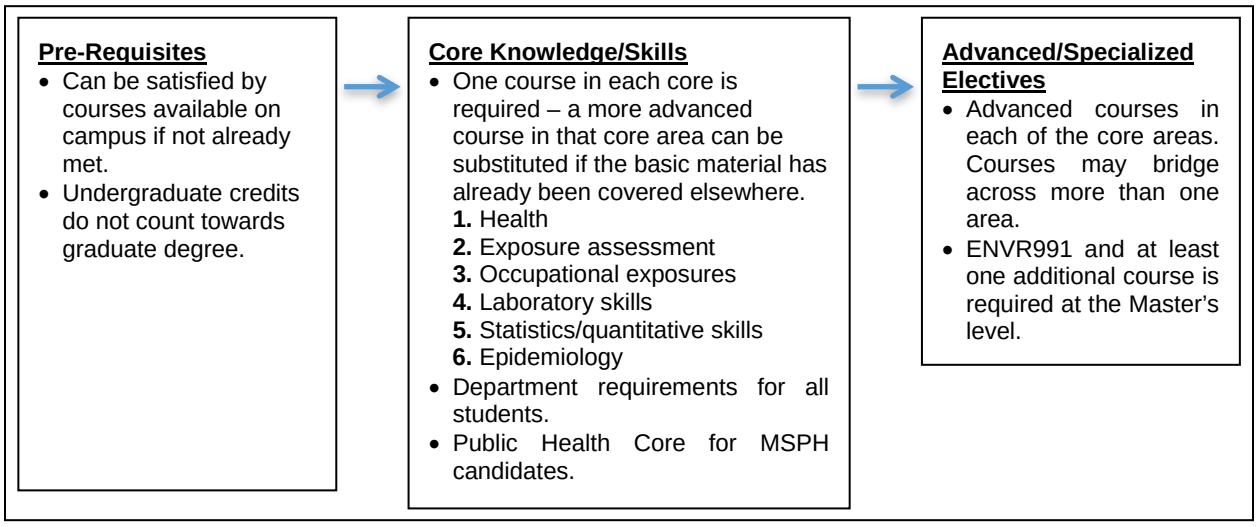

Figure 1. The overall structure of the OES Program curriculum.

Table F. The course requirements for the OES Program core knowledge areas.

Core Knowledge Area	Core Courses	Advanced/Specialized Courses
Health	ENVR430 or ENVR630	ENVR432, ENVR470†, ENVR707, ENVR732, ENVR770¶†‡,
Exposure assessment	ENVR640	ENVR769†, ENVR770*†‡, ENVR890†‡
Occupational exposures	ENVR433	ENVR770*¶†, ENVR890¶†
Laboratory skills	ENVR411 or ENVR431	ENVR991

Statistics/quantitative skills	BIOS545, BIOS600, ENVR468, or ENVR765†	ENVR470*, ENVR765¶‡, ENVR769¶‡, ENVR890¶‡, BIOS550, + BIOS551
Epidemiology	EPID600 or Epid module in ENVR401	Any appropriate advanced EPID course

* Bridge with Health

¶ Bridge with Exposure assessment

† Bridge with Statistics/quantitative skills

‡ Bridge with Occupational exposure

The OES Program core and advanced/interdisciplinary courses.

Core Courses	Credit	Semester	Faculty
Departmental requirements			
ENVR400 Seminar Series	1	Both	ESE Faculty
ENVR401 Unifying Concepts	3	Spring	Whalen
Health			
ENVR430 Health Effects of Environmental Agents	3	Fall	Ball
ENVR630 Systems Biology in Environmental Health	3	Spring	Fry
Exposure Assessment			
ENVR640 Environmental Exposure Assessment		Fall	Pleil
ENVR770 Biological Monitoring in Exposure Assessment	3	Spring	Nylander-French
ENVR890 Exposure Analysis	3	Spring	Flynn
Occupational Exposures			
ENVR433 Health Hazards of Industrial Operations	3	Fall	Flynn
Laboratory Techniques			
ENVR411 Laboratory Techniques and Field Measurements	3	Fall	Weinberg
ENVR431 Techniques in Environmental Health Science	2	Fall	Ball
Statistics/Quantitative Skills			
BIOS545 Principles of Experimental Analysis	3	Both	Biostatistics Faculty
ENVR468 Advanced Functions of Temporal GIS	3	Fall	Serre
ENVR765 Model-Based Exposure Mapping	3	Spring	Serre
Epidemiology			

	EPID600 Principles of Epidemiology	4	Both	Epidemiology Faculty
	ENVR401 Unifying Concepts (Epi Module)	3	Spring	Whalen/Fry
	Advanced/Interdisciplinary Courses			
	ENVR423 Industrial Toxicology (Health Effects)	2	Spring	Stopford
	ENVR432 Occupational Safety and Ergonomics	3	Fall	Wallace/Ostendorf
	ENVR470 Environmental Risk Assessment (Statistics)	3	Spring	McDonald-Gibson
	ENVR732 Health Effects of Outdoor and Indoor Air Pollution (Health Effects)	3	Fall	Hazucha
	PUBH785 Interdisciplinary Approaches in Occupational Health	3	Spring	Randolph/Rogers
	ENVR991 Research in OEES	3	Both	Core Faculty
	ENVR992 Master's Technical Report or ENVR993 Master's Thesis	3	Both	Core Faculty
	ENVR993 Ph.D. Thesis	3	Both	Core Faculty

During this period, we had 6 to 7 full-time faculty members and 9 to 10 adjunct faculty members each year. In 2006, Dr. Dana Loomis accepted a faculty and chair position at the University of Nevada. However, Dr. David Richardson, current director of the ERC Epidemiology program area at UNC-CH SPH, joined the EAC focus group and has actively been participating in the activities of EAC as well as training our students. In 2008, Dr. Louise Ball joined the EAC. Her expertise includes biochemistry, synthetic chemistry, and toxicology. Her expertise in analytical chemistry and synthesis of analytical standards for biological monitoring of occupational exposures has been and continue to be an utmost value to our group. She has extensively collaborated with the members of the EAC the past 10 years, particularly with Drs. Nylander-French and Rappaport. She has also served in a number of the EAC MS and doctoral student committees and has been actively teaching our students, in particular ENVR430 (Health Effects of Environmental Agents). Dr. Rappaport accepted a professorship at the School of Public Health, University of California, Berkeley, and moved to his new position July 1, 2008. However, he is an adjunct faculty member at the DESE and continued to advise students and collaborate with faculty in the DESE. In 2009, Dr. Rebecca Fry, Assistant Professor in ESE, joined the EAC and has been actively participating in the activities of the EAC as well as training our students. Her expertise includes toxicogenomics and systems biology and her teaching and research focuses on the biological effects of toxic exposures, including metals, to identify mechanisms of exposure associated diseases and the understanding of the basis for inter-individual disease susceptibility by the use of gene and epigenetic biomarkers.

During 2006-2011, the EAC graduated 18 PhD students and 26 Master's students (includes MS, MSPH, and MSEE). Seven of the Master's and three PhD students were fully supported by the NIOSH ERC training grant each year (see Trainees section below). During the academic year 2011-2012, we have 1 Master's and 2 PhD trainees; the Master's student is expected to

graduate May 2012. Half of our Master's graduates continued in a doctoral program, 7 doctoral graduates accepted postdoctoral fellowships, 6 Master's and 8 doctoral graduates accepted positions in government or academia. Four Master's and 1 PhD graduates accepted positions in the private sector. We have had 2-4 minority students advised by the EAC faculty and 1 minority student supported by IH traineeship during each year.

The EAC core faculty published 107 scientific articles (see **Literature Cited**), of which 21 were coauthored with ERC IH trainees, as well as 1 book and 3 book chapters during 2006-2011. The Journal of Environmental Monitoring featured our trainees' research in its cover (Gaines *et al.*, JEM 12:591-9, 2010). EAC core faculty and students delivered over 150 oral and poster presentations in both national and international meetings, and our NIOSH ERC IH trainees delivered 26 oral or poster presentations.

During 2006-2011, seven EAC students received poster, scientific achievement, or service awards. In 2006, Yasuyuki Akita recieved 3rd Place Poster Award in EPA Science Forum, William Allshouse received UNC-CH SPH Outstanding Research Award, and Kristen Hampton received UNC-CH Environmental Sciences Achievement Award. In AIHCe 2007, Kenneth Fent received Best of Session – 1st Place Student Poster Award and Jennifer Thomasen received 2nd Place Student Poster Award in the Gas and Vapor Detection Category (both IH trainees). In AIHCe 2008, Jennifer Thomasen received Best of Session – First Place Student Poster Award and Sheila Flack received Best Student Poster Presentation Award in Biological Monitoring Session Award (both IH trainees). Jennifer Thomasen and Sheila Flack (both ERC IH trainees) were selected as recipients of American Industrial Hygiene Foundation scholarships 2008-2009. Three of our IH trainees were successful in receiving funding from NC Occupational Safety and Health Education and Research Center Pilot Projects Program 2008-2009 (Jennifer Thomasen) and 2009-2010 (Sheila Flack and Zacchary Robbins) (each $10,000 direct cost) for two research projects to investigate (1) penetration patterns of HDI monomer and its oligomers in human skin and (2) metabolic pathways associated with exposure to 1,6-hexamethylene diisocyanate and risk of developing asthma. In 2010, Jennifer Thomasen was selected to deliver Student Spotlight Presentation and received a monetary award at the AIHA Carolinas Section Fall Professional Development Course and Conference in Greer, South Carolina. Linda Gaines and Sheila Flack (both IH trainees) received Goldberg Student Travel Award for the Society of Toxicology Annual Meeting, 2010. In addition, Professor David Leith was nominated by the UNC-CH for the National Professor of the year in Public Health, APHA/Pfizer in 2006. He was also awarded Bernard G. Greenberg Alumni Endowment Award for excellence in teaching, research and service to the broader public health community in 2008. Professors Rebecca Fry and Michael Flynn were co-recipient of Newton-Underhill Teaching Award in May 2011.

Since 2006, this training grant has allowed our trainees to participate in our joint research project with the University of Washington NIOSH ERC (Prof. Michael Yost) and the Safety & Health Assessment & Research for Prevention Program of the Washington State Department of Labor and Industry to investigate diisocyanate exposures in automotive refinishing industry (NIOSH R01-OH007598). This project has generated new and important knowledge on dermal and inhalation exposure levels to 1,6-hexamethylene diisocyanate as well as urine and blood biomarker data related to these external exposure levels. The data pertaining to inhalation exposure levels and means to provide additional protection for the workers were provided to

each of the automotive spray-painting facilities involved in this study. Research findings from this project have resulted in 11 published manuscripts and 3 have been submitted for publication to date. This research also generated additional collaboration with the University of Washington to investigate the effectiveness of protecting clothing to prevent diisocyanate exposure (NIOSH R01-OH009364). In June 2010, the IH trainees began field sampling in this project, which will continue until end of 2011. Mark Salsbury (IH trainee) was able to use this experience as a practicum for the MSPH degree requirement. In addition, we provided trainees with research experience in conducting filed studies to develop exposure assessment methods, to investigate exposure-dose-response relationships, and to calibrate models for the optimal control of exposure. NIOSH support has also provided funds for the trainees to attend national or international professional meetings to present results from their research projects. For example, each year 1-3 trainees have participated in the American Industrial Hygiene Conference. In addition, NIOSH support has allowed our trainees to participate in teaching and outreach activities. In 2010, Sheila Flack and Jennifer Thomasen (both IH trainees) participated in FEMMES (Females Excelling More in Math, Engineering, and Science) outreach program, which introduces young women (4th through 6th grade) to math, science, and engineering, by directing a hands-on activity that highlighted industrial hygiene education and professional practices.

NIOSH ERC IH Trainees

The IH traineeships supported 3 Master's and 2 doctoral students in 2006-2007; 1 Master's, 1 MS/PhD, and 2 doctoral students in 2007-2008; 1 Master's and 3 doctoral students in 2008-2009; 1 Master's and 3 doctoral students in 2009-2010; and 4 Master's students in 2010-2011. During 2006-2010, we had 1 minority student supported by the IH traineeship. The accomplishments of each research trainee supported during 2006-2011 are summarized below.

Master's Students

1. **Flack, Sheila** (MSPH 2006; Advisor Leena A. Nylander-French); Thesis title: *Dermal and Inhalation Exposure to Propiconazole among Farm Workers in North Carolina*. The purpose of this study was to assess dermal and inhalation exposure to propiconazole among farmer workers during pesticide handling (i.e., mixing, loading and crop application) and to understand which factors (e.g., environmental and behavioral) may contribute to propiconazole exposure. This research was carried out in collaboration with Dr. Goktepe at NC A&T University, a minority institution. Ms. Flack presented her research at the Society of Toxicology meeting 2006, AIHCe 2006, and ISEA 2007. Publication: Flack, Goktepe, Ball, Nylander-French: Development and evaluation of quantitative monitoring methods for dermal and inhalation exposure to propiconazole. JEM 10:336-4, 2008. Ms. Flack continued as a doctoral student in ESE.

2. **Hamra, Ghassan** (MSPH 2007; Advisors David Richardson and Leena A. Nylander-French); Thesis Title: *Dose Reconstruction for an Occupational Cohort at the Savannah River Nuclear Facility: Evaluation of a Hybrid Method*. Nuclear plant workers' exposure to tritium and development of an exposure model. Mr. Hamra presented his research at ISEA 2007. Publication: Hamra, Nylander-French, Richardson: Dose reconstruction for an occupational cohort at the Savannah River nuclear facility: evaluation of a hybrid method. Radiat Prot

Dosimetry 131(2):188-97, 2008. Mr. Hamra continued as a doctoral student in Epidemiology, UNC-CH.

3. **Buchanan, Tausha** (MSPH 2007, Advisor David Leith); Thesis title: *Penetration of Fine Particles Through Simulated Building Cracks*. Ms. Buchanan investigated the relationship between pressure differential across the wall of a building and aerosol infiltration through cracks and gaps in the building structure. The aerosols of concern range from 10 nm to 5 µm in diameter. Experimental data was developed and matched against relevant theory. Her research project was carried out in collaboration with Drs. R. Mosely and J. Rosati at USEPA, RTP, NC. Ms. Buchanan is employed as a consulting engineer.

4. **Thomasen, Jennifer** (MSPH 2007; Advisor Leena A. Nylander-French) Thesis title: *Laboratory and Field Comparisons of Air Sampling Methods for 1,6-Hexamethylene Diisocyanate*. The objective of this study was to evaluate the performance of commonly used sampling devices for 1,6-hexamethylene diisocyanate in both the laboratory and occupational field setting. Ms. Thomasen presented her research at the AIHCe 2007 where she received 2nd Place Student Poster Award in the Gas and Vapor Detection Category and at ISEA 2007. Ms. Thomasen continued as a doctoral student in ESE.

5. **Anderson, Daniel** (MSPH 2008; Advisors John Dement and Leena A. Nylander-French); Thesis title: *Application of a Lung Deposition Model to Fiber Data from Three North Carolina Asbestos Textile Plants*. The goal of this research was to apply a lung deposition model to size-specific TEM fiber aerosol data in order to create a framework by which nasopharyngeal, tracheobronchial, and pulmonary is estimated and, thus, improve upon the predictive capacities of existing exposure-response models in epidemiologic studies. Mr. Anderson presented his research at AIHCe 2008. Mr. Anderson is employed as a Public Health Officer, US Air Force.

6. **Messier, Kyle** (MS 2011; Advisor Marc Serre); Thesis Title: *Integration of a Contaminant Source Land Use Regression Model in the Bayesian Maximum Entropy Spatiotemporal Geostatistical Estimation of Groundwater Tetrachloroethylene across North Carolina*. The assessment of groundwater tetrachloroethylene (PCE) exposure across North Carolina is currently hindered due to limited statewide spatiotemporal contaminant maps. This work introduces a novel integrated land use regression (LUR) and Bayesian Maximum Entropy (BME) approach, which produces accurate visual representations of PCE exposure across North Carolina. These maps provide valuable information to develop control strategies to reduce exposure to vapor intrusion of PCE from the groundwater, which is particularly critical for workers in buildings located above PCE contaminated aquifers. Mr. Messier continued as a doctoral student in ESE.

7. **Robbins, Zachary** (MS 2011; Advisor Leena A. Nylander-French); Thesis Title: *Determination of Aliphatic Amines in Urine as Biomarkers of Exposure to 1,6-Hexamethylene Diisocyanate and Isocyanurate*. The objective of this study was to develop a liquid chromatography-mass spectrometry method to detect HDA, monoacetyl-HDA, diacetyl-HDA, and isotriamine in urine. Mr. Robbins and Ms. Flack obtained a pilot grant from NC Occupational Safety and Health Education and Research Center Pilot Projects Program 2009-

2010 to investigate metabolic pathways associated with exposure to HDI and risk of developing asthma. Mr. Robbins continued as a doctoral student in ESE.

8. **Salsbury, Mark**: (MSPH 2011; Advisor Leena A. Nylander-French); Thesis Title: *Evaluation of Exposure to Acetamiprid in Pesticide Applicators*. The goal of this study is to develop a tape-strip method to quantify dermal exposure to acetamiprid and to investigate if acetamiprid in urine can be used as a biomarker of dermal exposure. This project is a collaborative effort with Dr. D. Clements and S. Fetzko at Global Health Institute, Duke University, to investigate pesticide applicators exposure in Honduras. Mr. Salsbury will graduate in August 2011.

9. **Bush, Robert** (MS 2012; Advisor David Leith); Thesis topic: *Investigation of a possible link between spraying of sewage treatment plants sludge and human health*. In many parts of the country, sludge from sewage treatment plants is sprayed onto farm fields for disposal and for use as fertilizer. Concern has developed that this spray could affect the health of the workers who spray and those who live in nearby residences. Mr. Bush's responsibility is to develop a passive method to monitor air pollutants generated by sludge spraying. This project is a collaborative effort with Dr. Steve Wing at Epidemiology, UNC-CH.

OCCUPATIONAL EPIDEMIOLOGY REPORT

The period covered by this report is 7/1/2007-6/30/2012.

Occupational Epidemiology is an allied component research program that has been part of the UNC ERC since 2001. The mission of the occupational epidemiology program is to train highly-qualified scientists who will develop and apply the theory, methods and substance of epidemiology to protect workers' safety and health. With the program now in its tenth year, we are emphasizing engaging trainees in high-quality research on occupational health and safety, supporting trainees in contributing scholarly publications, and ensuring that they successfully complete the program.

The program is led by Dr. Richardson with seven affiliated core program faculty. The program has recently been enhanced by the addition of one new program faculty member, Dr. Lawrence Engel. The course of study leads to the PhD and is designed for students with a Master's degree in epidemiology or a related field. Training activities include required and elective courses, mentored research practica, interdisciplinary seminars, preliminary written and oral examinations, participation in research, and the development and execution of the doctoral dissertation project. Support from NIOSH provides valuable enhancements to the occupational epidemiology program through courses, seminars and opportunities to be exposed to other occupational health disciplines.

A typical curriculum for an Occupational Epidemiology trainee with a Master's degree is shown below.

Sample curriculum for occupational epidemiology predoctoral trainees with a previous Master's degree.

Course Number and Title		Credit Hours
Year 1, fall semester		
EPID 705	Introduction to Logic and Probability in Epidemiology*	2
EPID 710	Fundamentals of Epidemiology*	4
BIOS 600	Principles of Statistical Inference*	3
ENVR 433	Health Hazards of Industrial Operation**	3
Year 1, spring semester		
EPID 715	Theory and Quantitative Methods in Epidemiology*	5
BIOS 545	Principles of Experimental Analysis*	3
EPID 770	Cancer Epidemiology and Pathogenesis	3
Year 2, fall semester		
EPID 718	Advanced Methods for Epidemiologic Data Analysis*	5
PUBH 785	Interdisciplinary Approaches in Occupational Health H	3
BIOS 665	Analysis of Categorical Data**	3
Year 2, spring semester		
ENVR 432	Occupational Safety and Ergonomics **	3
EPID 726	Epidemiologic Research Methods*	3
EPID 780	Occupational Epidemiology H	3
EPID 722	Epidemiologic Analysis of Time-to-Event Data*	3
Year 3, fall semester		
EPID 394	Dissertation	3 (typical)
Year 3, spring semester		
EPID 394	Dissertation	3 (typical)

*Required for the PhD in epidemiology

**Elective

H Required for NIOSH occupational epidemiology trainees

Participation in the ERC Continuing Education program is accomplished as needed. Over the past 5 years reporting period an Occupational Epidemiology course was offered through Continuing Education four times. Dr. Richardson reviewed course materials. The course was held one time and taught by the state epidemiologist with 5 registrants. The 3 subsequent courses were cancelled due to low registration. Also, needs assessments have not demonstrated a requested need for this content.

NIOSH support through the OSHERC has influenced the curriculum by improving opportunities for trainees to attend seminars on occupational health. NIOSH training-related expenses provide some support for faculty salaries, which facilitated program direction and course development. Funds are also used for communication, research supplies, copying, and literature searches which facilitate collaboration and support trainees' involvement in research. The Occupational Epidemiology Program has been successful in maintaining a high level of external research support. A number of these projects are notable for their interdisciplinary collaboration and their involvement of faculty from other programs, for example, Dr. Richardson, Dr. Loomis, and Dr. Dement (Duke OM program) are undertaking a major study of lung cancer among asbestos workers; and Drs. Richardson, Cole, and Loomis have been awarded a grant to develop methods for occupational cohort studies.

Program Trainees

The program's most important accomplishments have been the recruitment, training and career placement of highly-qualified, productive occupational health scientists. Five trainees have received support over the last five years. These trainees have followed the training program leading to the PhD. Training grant support from NIOSH provides for the availability of traineeships which is often a critical factor in students' decisions about which research areas and projects they pursue.

1. Ghassan Hamra, PhD, (dissertation chair, David Richardson).
Appointed as a trainee in 2008, and completed the PhD in 2011.
Dr. Hamra's research at UNC focused on occupational exposure to tritium among workers at the Savannah River Site. His dissertation, titled "Bayesian Methods for the Evaluation of Tritium: Relative Biological Effectiveness and Cancer Risk" was a cohort analysis among SRS workers and was one of the first studies to quantify dose-response associations for leukemia among workers exposed to tritium; this was accomplished using a Bayesian regression framework. He has also been involved in methodological research on regression models with Dr. Richardson. Dr. Hamra is currently in the first year of post-doctoral training supported by the National Institute of Environmental Health Sciences.

Publications

Hamra G, Richardson DB, Nylander-French L. "Dose reconstruction for an occupational cohort at the Savannah River nuclear facility: Evaluation of a hybrid method." Radiation Protection Dosimetry (2008) 131: 188-197

Richardson DB, **Hamra G**. "Ionizing radiation and kidney cancer among Japanese atomic bomb survivors." Radiation Research (2010) 173: 837-842

Hamra G, Richardson D, MacLehose R. Markov Chain Monte Carlo: An introduction for epidemiologists. Epidemiology 2011 (under review).

Hamra G, Richardson D, MacLehose RF,Wing SB. "Tritium: Cancer risk and relative biological effectiveness" (in preparation).

Hamra G, Richardson D, MacLehose RF. “Informative priors: a simple approach for utilizing animal and cellular evidence in observational research via order constrained priors" (in preparation).

Presentations

Hamra G, Richardson DB, MacLehose R. “Informative priors: a simple approach for utilizing animal and cellular evidence in observational research via order constrained priors. EPICOH, Oxford, UK, 2011

Hamra G, Richardson DB, Nylander-French L. “Dose Reconstruction for an Occupational Cohort at the Savannah River Nuclear Facility: Evaluation of a hybrid method.” International Society of Exposure Analysis, 17th Annual Meeting, Durham, NC, 2007.

2. Steve Lippmann, PhD (advisor, David Richardson).
Appointed as a trainee in 2008.
Mr. Lippmann obtained his MSPH degree in 2009, completing his master’s thesis on occupational exposures among taxi drivers, titled “Elevated serum liver enzymes and fatty liver changes associated with long driving among taxi drivers.” He is currently working toward completion of the PhD; he is expected to graduate the doctoral program in 2012. Mr. Lippmann’s dissertation research centers on occupational injury with a focus on heat-related injury. His dissertation research will examine heat related injuries among workers in North Carolina. Mr. Lippmann was co-author with Dr. Richardson of one published paper and has prepared several others publications for submission.

Publications

Lippmann S, Richardson DB, Chen JC. Elevated serum liver enzymes and fatty liver changes associated with long driving among taxi drivers. American Journal of Industrial Medicine (accepted, April 2011).

Publications submitted

Kristen Hassmiller Lich, Debbie Travers, Wayne Psek, Morris Weinberger, Karin Yeatts, Winston Liao, **Steven J. Lippmann**, Levi Njord, Anna Waller. Emergency Department Visits Attributable to Asthma in North Carolina, 2008. North Carolina Medical Journal (Submitted April 12, 2011).

Publications in process

Steven J. Lippmann, David B. Richardson. Temperature and emergency department visits for heat-related illness in North Carolina, 2007-2008. (in preparation)

3. Jerrod Nelms, MPH (advisor, David Richardson).
Appointed as a trainee in 2010. Mr. Nelms is making satisfactory progress toward completion of the PhD and is expected to graduate in 2013. Mr. Nelm’s research centers on occupational injury with a focus on intentional injury at work. His dissertation research will examine robbery related homicide among workers in North Carolina. He has completed his coursework and is in the process of his interim review, having completed a first draft of the aims of his dissertation project.

Publications

Golla J, **Nelms J**, Taylor R, Mishra S. Pesticide Concentrations in Drinking Water from Farm Homes: Variations between Community Water Supply and Well-Water. Journal of Environmental Science and Engineering (accepted, 2011).

4. Kim Angelon Gaetz, MPH (advisor, David Richardson)

Ms. Gaetz was appointed as a trainee in 2011. She is making satisfactory progress toward completion of the PhD and is expected to graduate in 2012. Dr. Richardson is the chair of her dissertation committee. Her project, titled "Free to Breathe, Free to Teach: Indoor Air Quality in Schools and Respiratory Health of School Teachers" data focuses on occupational asthma among North Carolina public school teachers. She has completed over half of the field data collection, which includes environmental monitoring in classrooms and ongoing collection of respiratory symptom data. Ms. Angelon Gaetz was co-author with Dr. Richardson of one published paper and has presented her master's work at the American Public Health Association meeting.

Papers

Angelon-Gaetz KA, Richardson DB, Wing S. Inequalities in the nuclear age: Impact of race and gender on radiation exposure at the Savannah River Site (1951-1999). New Solutions: A Journal of Environmental and Occupational Health Policy (2010) 20:195-210

Presentations

Gaetz, K. 2011. Educational Outreach and Research Goals of the "Free to Breathe, Free to Teach" Project. North Carolina Asthma Summit. Research Triangle Park, NC.

Yeatts, K; D Richardson; **K Gaetz**. 2010. Free to Breathe, Free to Teach: Indoor Air Quality in Schools and Respiratory Health of Teachers. CEHS Symposium on Interdisciplinary Environmental Health Research, Chapel Hill, NC.

Angelon K, Richardson DB, Wing S. "Inequalities in the nuclear age." American Public Health Association, 135th Annual Meeting, Washington DC, 2007

5. Alex Kiel, MPH (advisor, David Richardson).

Mr. Kiel was appointed as a trainee in 2010. He is making satisfactory progress toward completion of the PhD and is expected to graduate in 2012. Mr. Kiel's research centers on occupational cancer with a focus on quantification of radiation risks among underground miners. His dissertation research will examine lung cancer mortality in an updated cohort of underground uranium miners with a focus on use of marginal structural models to control for the healthy worker survivor effect. Mr. Kiel was co-author with core faculty member Dr. Wing on one published paper and has presented at the American Public Health Association meeting.

Publications

Keil A, S Wing, A Lowman. 2011. Suitability of Public Records for Evaluating Health Effects of

Sewage Sludge in North Carolina. North Carolina Medical Journal (in press).

Presentations

Keil A, Cole S, Richardson DB. Inverse probability weighted models of arsenic effects on cancer in a copper smelter cohort. EPICOH, Oxford, UK, 2011

CITED LITERATURE

Loomis, D., J. F. Bena, et al. (2003). "Diversity of trends in occupational injury mortality in the United States, 1980-96." Inj Prev **9**(1): 9-14.

Loomis, D., D. Richardson, et al. (1997). "Fatal occupational injuries in a southern state." American Journal of Epidemiology **145**(12): 1089-1099.

Loomis, D., M. D. Schulman, et al. (2009). "Political economy of US states and rates of fatal occupational injury." Am J Public Health **99**(8): 1400-1408.

Richardson, D., D. Loomis, et al. (1997). "Fatal agricultural injuries in North Carolina by race and occupation, 1977-1991." American Journal of Industrial Medicine **31**(4): 452-458.

Doctoral Students

1. Flack, Sheila L. (PhD 2010; Advisor Leena A. Nylander-French); Thesis Title: *Biological Monitoring of Occupational Exposure to Monomeric 1,6-Hexamethylene diisocyanate*. The objective of this research was to develop and apply quantitative methods for the analysis of novel blood and urinary biomarkers stemming from exposure to HDI monomer to be utilized in exposure assessment and epidemiology studies. Ms. Flack presented her research at the 7th ISBM 2007 in Beijing, AIHCe 2008 where she received Best Student Poster Presentation Award in Biological Monitoring Session, at the Society of Toxicology meeting 2010 (received Goldberg travel award from UNC-CH Curriculum of Toxicology), and AIHCe 2010**.** Ms. Flack also received American Industrial Hygiene Foundation Carolinas Local Section Scholarship and the Fred Venable/Deep South Local Section Scholarship 2008-2009. Ms. Flack and Mr. Robbins obtained a pilot grant from NC Occupational Safety and Health Education and Research Center Pilot Projects Program 2009-2010 to investigate metabolic pathways associated with exposure to HDI and risk of developing asthma. Publications: (1) Flack, Ball, Nylander-French. Occupational exposure to HDI: progress and challenges in biomarker analysis. J Chromatogr B Analyt Technol Biomed Life Sci 878(27):2635-42, 2010; (2) Flack, Fent, Trelles Gaines, Thomasen, Whittaker, Ball, et al. Quantitative plasma biomarker analysis in HDI exposure assessment. Ann Occup Hyg 54(1):41-54, 2010; (3) Flack, Fent, Gaines, Thomasen, Whittaker, Ball, et al. Hemoglobin adducts in workers exposed to 1,6-hexamethylene diisocyanate. Biomarkers 16(3):261-70, 2011. She is currently a post-doctoral in ESE continuing development of novel biomarker analyses for xenobiotics and investigating the applicability of whole genome-wide analysis methodologies in exposure science.

2. Gaines, Linda G.T. (PhD 2010; Advisor Leena A. Nylander-French); Thesis Title: *1,6-Hexamethylene Diamine (HDA) as a Urinary Biomarker for Dermal and Inhalation Exposure to 1,6-Hexamethylene Diisocyanate (HDI) in Automotive Spray-Painters*. The objective of this research was to establish a quantitative and time-dependent relationship between urine 1,6-hexamethylene diamine (HDA) levels and inhalation and dermal exposure to 1,6-hexamethylene diisocyanate (HDI). Ms. Gaines presented her research at the Society of Toxicology meeting 2010 (received Goldberg travel award from UNC-CH Curriculum of

Toxicology) and AIHCe 2010 in Denver. Publications: (1) Gaines, Fent, Flack, Thomasen, Ball, Richardson, et al. Urine 1,6-hexamethylene diamine (HDA) levels among workers exposed to 1,6-hexamethylene diisocyanate (HDI). Ann Occup Hyg 54(6):678-91, 2010; (2) Gaines, Fent, Flack, Thomasen, Ball, et al. Effect of creatinine and specific gravity normalization on urinary biomarker 1,6-hexamethylene diamine. J Environ Monit 12(3):591-9, 2010; (3) Gaines, Fent, Flack, Thomasen, Whittaker, Nylander-French. Factors affecting variability in the urinary biomarker 1,6-hexamethylene diamine in workers exposed to 1,6-hexamethylene diisocyanate. J Environ Monit 13 (1):119-27, 2011. Ms. Gaines is employed as an Environmental Health Scientist at US EPA, Washington, DC.

3. Thomasen, Jennifer (PhD 2011; Advisor Leena A. Nylander-French); Thesis Title: *Investigating the Performance of Exposure Assessment techniques Used to Monitor Air and Dermal Exposures to Monomeric and Polymeric 1,6-Hexamethylene Diisocyanate*. The goal of this research was to investigate the performance of air and dermal exposure assessment techniques used to monitor exposures to monomeric and polymeric 1,6-hexamethylene diisocyanate (HDI). Ms. Thomasen presented her research at AIHCe 2008 where she received Best of Session, First Place Student Poster Award as well as at AIHCe 2010 and 2011 where she received the best student poster award by the AIHA Dermal Project Team. Ms. Thomasen received the American Industrial Hygiene Foundation Scholarship 2008-2009. She also received a pilot grant from NC Occupational Safety and Health Education and Research Center Pilot Projects Program 2008-2009. Jennifer was selected to deliver Student Spotlight Presentation and received monetary at the AIHA Carolinas Section Fall Professional Development Course and Conference 2010 in Greer, SC. For the last year of her doctoral studies, Ms Thomasen was supported by our NIOSH grant (NIOSH R01-OH009364) stemming from our collaboration with the University of Washington NIOSH ERC to investigate the effectiveness of protective clothing to prevent diisocyanate exposure. Publications: (1) Thomasen, Fent, Reeb-Whitaker, Whittaker, Nylander-French. Field comparison of air sampling methods for monomeric and polymeric 1,6-hexamethylene diisocyanate. J Occup Environ Hyg 8(3): 161-78, 2011; (2) Thomasen, Fent, Nylander-French. Development of a sampling patch to measure dermal exposures to monomeric and polymeric 1,6-hexamethylene diisocyanate: a pilot study. J Occup Environ Hyg, in press; (3) Thomasen, Nylander-French. Skin penetration patterns of monomeric and polymeric 1,6-hexamethylene diisocyanate. J Environ Monit, submitted. She is currently a post-doctoral fellow in ESE continuing development of novel exposure assessment techniques for isocyanate exposure and investigating the methodologies to prevent diisocyanate exposure.

4. Robbins, Zachary (PhD; Advisor Leena A. Nylander-French); Thesis topic: *Biomarkers of 1,6-hexamethylene diisocyanate monomers and oligomers in urine and blood*. Biological monitoring of 1,6-hexamethylene diisocyanate (HDI) exposure has been limited to the hydrolysis product of HDI monomer (HDA) and no methods exist to measure biomarkers of oligomer exposures, which are more prominent that monomer exposure in autobody-repair industry. The goal of this research is to develop and validate new methods to analyze biomarkers of HDI monomer and oligomers. These methods will be applied to urine and blood analyses of exposed spray painters to investigate the dose-response relationships and to assess the applicability of these biomarkers in exposure assessment and epidemiology studies.

5. Messier, Kyle (PhD; Advisor Marc Serre); Thesis topic: *Development of a framework that utilizes Bayesian Maximum Entropy (BME) and land use regression (LUR) to estimate exposure to toxins*. The research project will consist of using space/time estimates of tetrachloroethylene (PCE) exposure and diseases rates to examine a potential association between PCE exposure and health effects such as increased renal cancer incidence.

CONTINUING EDUCATION PROGRAM

Considered a premier educational provider of interdisciplinary continuing education in occupational and environmental health and safety in the region, the NC OSHERC CE Program at UNC-CH Gillings School of Global Public Health has been serving the educational needs of all disciplines in the Southeast for over 30 years. Faculty reputation and strength has been demonstrated by the number of highly recognized academic and non-academic instructors who have been associated with the CE Program. Every core program has both types of faculty represented in the CE Programs and have assisted the CE Program with meeting its missions, goals, and objectives.

Objectives were based on needs assessments and accomplishments for the previous grant periods and include the following:

1. Train 1000 students annually for the CE Program;
2. Conduct and analyze needs assessments annually;
3. Continue to market CE and provide outreach to current organizations;
4. Increase diversity enrollment by 5% based on data from CE registrations;
5. Increase Union worker attendance by 5% in two years;
6. Increase attendance of four local government employees; and
7. Increase physician attendance by 10%.

Discussion of Progress and Accomplishments

CE Program Trainees participating in the NC OSHERC programs in the past year numbered **3,718** in **106** courses surpassing the objective to train 1000 students and the NIOSH requirement of 600 trainees. In the past five years of the project period, trainees numbered **22,102** students in **690** offerings.

1. Geographic statistics indicated that **82%** of CE students were from the Southeast, EPA Region IV, demonstrating meeting regional needs. The students consist of two major categories: 1) professional occupational safety and health practitioners who require professional development credits and certification review courses; and 2) students who work in a technical capacity with occupational health and safety responsibilities.

These CE trainee numbers include many participants who were offered waived or reduced registration fees. Many of these attendees experienced job losses and business downsizing in a poor economy. The CE Program has been able to maintain numbers of participants and courses by offering students these financial incentives in order to

continue to provide the educational services and keep the customer base. We have been financially challenged by the economy over the last several years with downsizing and reduction in business travel and education funds. However, the CE Program has continued to keep the numbers well over the NIOSH requirement of 600 trainees per year.

2. Needs assessments have been continuously conducted and analyzed throughout the project period. For analysis, a variety of methods were used to collect the data that includes: CE course participant evaluations; visitors surveyed at the NIOSH CE ERC and NC OSHERC exhibit booths at professional conferences and meetings, surveys from collaborating professional associations which provided their data, and shared data from the other two EPA Region IV (Southeast) ERC CE Programs, Sunshine ERC from the University of South Florida and Deep South ERC from the University of Alabama at Birmingham. Of 1190 surveys conducted through CE activities during the project period, the top 10 requested courses have been offered. The needs assessment data have been analyzed and indicated that the most frequently requested courses include the following: 1) Respiratory Protection; 2) Fundamentals of Occupational Safety; 3) Fundamentals of Industrial Hygiene; 4) OSHA 30-Hour General Industry Standards; 5) Safety Inspections/Auditing; 6) Certification Review courses; 7) Asbestos Training; 8) Indoor Air Quality/Mold; 9) Industrial Hygiene Sampling; and 10) Ergonomics. Most of these courses were offered at least twice a year. All were offered at least once annually.

3. Marketing CE and providing outreach to current organizations was expanded to increase opportunities for new audiences and included the following: Email blasts were sent every month to approximately 30,000 potential students; “Adwords” were purchased for primary Internet “Google search” positioning; notices were sent through AOEC newsletters and OEM listservs; co-sponsored offerings were marketed to members of the respective professional associations; News-E (semi-annual NC OSHERC Newsletter) advertised courses; individual mailings and Emails were sent to potential customers; and outreach promoted all the programs of the NC OSHERC. Outreach was provided to the following:

- UNC Minority Health Conference was provided with speakers and materials;
- NC A&T State University, a HBCU, was assisted through the CE Director’s participation on the Construction and Safety Advisory Board, reviewing programs and content, providing free registrations for students and faculty, providing materials, editing a textbook draft for a professor, and assisting professors with program development for their own outreach;
- Several Native American Indian tribes and Black and Hispanic/Latino Chambers of Commerce were contacted and offered assistance with educational offerings, presentations on the OSH careers and opportunities, and the loaning of equipment and materials for training;
- Advisory Board participation was accomplished by the CE Director and includes: NC A&T University and the NC EMS RRT composed of Fire, Rescue, HAZMAT, and

Public Safety departments, which have higher percentages of minority workers to whom educational courses were offered at waived or reduced registration fees. The International Association of Fire Fighters (IAFF) was contacted on several occasions to provide free training for NC firefighters;

- Serving in leadership roles in professional organizations was a high priority. The CE Director served on the Board and Education Committee and as Communications Director for the NCAOHN, writing and producing a semi-annually newsletter. She served as Chair of the Research and Communications Committees for Director for the NCTAOHN, producing the semi-annual newsletter, which was honored to receive the AAOHN Communications Award. She has taught or provided speakers several times a year for the local, state, and national level for chapters of AAOHN. She served as an appointed member of the ICOH committee titled "Participatory Approaches in Occupational Health." She served on the Advisory Board for the NC Ventilation Conference and the Central Carolina Safety School sponsored by the NC Department of Labor and participated annually in the Annual NC Statewide Safety Conference.

4. Diversity enrollment increased by 2%, but did not reach the objective of 5% for the project period based on lower CE registrations and companies cutting back on training and travel expenditures. The new CE objective was changed to increase minority enrollment by 2% for the next project period or until the economy improves. Until that time, we market to agencies and organizations with higher minority workforces. Diversity students have increased because of increased outreach to HBCU, to areas of employment of Black and Hispanic workers, such as construction and solid waste workers, Black and Hispanic/Latino Chambers of Commerce, referrals of workers from the EPA and DHHS websites, and by word of mouth. For 2010-2011, the diversity breakdown of attendees reporting their ethnic background was consistent: White: 82%; Black: 8%; Hispanic: 5%; Asian: 3%; American Indian: 2%.

5. Union participation increased by 2%. Contacting several unions and marketing to several companies who have employees represented by Unions has resulted in increased student participation from Unions through this Outreach. Because of the economy and restricted travel and educational funding, we will change the objective for the next project period to 2% increase.

6. Four local government employees attended the Winter and Summer Institutes with waived registration fees and travel paid by the CE Program. This outreach and collaboration assisted funding educational opportunities for state and local employees who otherwise would not have been able to attend.

7. Physician attendance was increased by more than 10% and continues to increase with the collaboration of Duke University's OM Program and extended to provide marketing and outreach to family practice and urgent care physicians. The Virginia College of Occupational and Environmental Medicine (VCOEM) joined with the Carolinas Occupational and Environmental Medicine Association (COEMA) to form the SEACOEM and held their first conference with an increase in physician attendance. NC OSHERC

continues to assist in the development and presentation of the Annual SEACOEM Symposium, suggesting topics, working with speakers, applying for CME/MOC credits, taking registrations, and providing AV equipment and on-site registration and technical assistance. In addition, at the recommendation of Dr. Bonnie Rogers, a meeting for the possible development of a joint OHN/OM conference was held, which provides a new interdisciplinary approach to occupational health and medical education for the region. The joint meeting of OHN and OM participants from NC, SC, and VA will be held in 2012.

Partnerships with other training providers in the Southeast region assisted all parties in ensuring that the training courses were not in direct competition or offered at the same time. The primary major training partners were: Workplace Group; PCIH Consulting; Herrick Engineering; Hepaco, Inc.; IESO, LLC; EI, Inc.; CTJ Safety Associates; NC DOL; and NC EMS. We also refer students to other ERCs and other training providers to best suit the needs of the students. NC OSHERC has a reputation of providing excellent education because of the curriculum and faculty associated with UNC. Therefore, we have been aware of what and when courses were offered and have collaborated with some of the providers. When in a competitive situation, NC OSHERC has been challenged to provide lower pricing for courses while paying consultants as NC OSHERC instructors when other training providers in the Southeast have paid instructors on staff.

Collaboration with two regional ERCs on chosen education offerings in the Southeast ensured a balance of offerings for the region. For example, we offered an intensive 4.5 day Respiratory Protection Course, compared to UAB offering a three-day course for those who needed less content and hands-on skills. While in Florida at the Winter Institute, the USF co-sponsored the Hearing Conservation course with NC OSHERC and has offered other courses, such as Disaster Preparedness and Hurricane Preparedness at our Winter Institute. The three ERC CE Programs also produced three annual Research–to-Practice presentations at the interdisciplinary Annual Florida Workers' Compensation Institute, a conference which draws over two thousand attendees from the Southeast. Professor Rod Handy, PhD, CIH from Purdue University, a NIOSH TPG, provided additional NIOSH-related collaborations such as providing materials and teaching opportunities in Environmental Health, Environmental Regulations, and IH Sampling. The CE Director worked with the NC DHHS Occupational and Environmental Epidemiology Section on a new initiative called "SouthOn" for building state-based occupational health and safety surveillance capacity in a collaboration with Louisiana, Alabama, North Carolina, Florida, Georgia, South Carolina, West Virginia, Mississippi, Texas, and Kentucky that will provide a basis for identifying training needs and target audiences in a collaboration with other southern states and NIOSH ERCs.

Program Products included the following innovations and new offerings based on needs assessments:

1. New Courses based on needs assessments included four new semi-annual courses offered: **OSHA 30-Hour General Industry for Healthcare, Toxicity of Chemicals for Health and Safety Professionals, Preparing for an OSHA Combustible Dust Inspection, and OSHA Recordkeeping. T**heir potential impact on worker safety and

health has been statements from students that the knowledge and skills acquired from these courses prepares them to follow the OSHA standards designed to protect worker health and safety. A new course developed was Ethics for Industrial Hygienists, a 2010 requirement for the certification and re-certification of the CIH. This was offered three times this past year and is being developed as an online offering by the IH PD. The potential impact on worker safety and health was that this course re-enforces the various areas of ethics that CIHs are expected to follow when faced with pressure from employers to divert from acceptable practices. A relationship was developed with the OSHA Training Institute at Eastern Kentucky University to provide OSHA 501 and 511 courses at the Institutes. The CE Program already has OSHA certified instructors. Most of these courses were held at the two week-long semi-annual Institutes.

2. Short (one-day) Safety courses offered in Chapel Hill was implemented to meet requested needs. Several one-day offerings were presented during the week in five sessions for a total of 19 safety courses presented over 5 months. Course evaluations were excellent, so they have been scheduled to be repeated annually. Their potential impact on worker safety and health was evident when the trainees state that they were not familiar with the health and safety materials presented that were necessary to protect the workers and keep businesses OSHA-compliant.

3. Professional Certification Review Courses were offered to fulfill the needs of the professional practitioner to become certified in their specialty disciplines. Through Certification Review Courses that consistently result in much higher passing rates than national rates, CE credits were provided for certifications that also require CE maintenance education. Therefore, all courses have an option of CEUs from UNC and relevant courses receive credit from the disciplines' Certification Boards. The following Certification Review Courses were offered annually or semi-annually: Safety (ASP and CSP), Industrial Hygiene (CIH), Occupational Health Nursing (COHN(S) and COHN/Safety Management), Hazardous Materials Manager (CHMM), Chemical Hygiene Officer (CHO), and **Biological Safety Professional (CBSP)**. Post course surveys were conducted 6-12 months after the course to document the course value and passing rates for the certification exams. Students reported that they received pay increases and promotions from certifications and their knowledge and skills from the courses have better prepared them to recognize and correct workplace hazards.

4. Online Courses were offered based on the needs assessment results. One online course (Fundamentals of Industrial Hygiene) has been offered semi-annually and another (Fundamentals of Occupational Safety) has been delayed in the development process for financial reasons and because UNC has changed its application from Blackboard to Sakai. One new online course has been in development called Ethics for Industrial Hygienists by the IH PD and the CE Director.

5. Three Technician Certificate Programs have been available and many students have completed all three of the Certificates that were reported under CE: Safety, Industrial Hygiene; and Environmental. As the roles expand for the health and safety professionals, students take courses that traditionally were considered to be focused on

different disciplines. Many students identified with one specialty area take courses typically not associated with their field, providing interdisciplinary education. These trainees were also technician level workers who required increased knowledge and skills, but are not pursuing academic degrees. Passing exams for Certificate Programs also demonstrate success. The Technician Certificate Programs have graduated 22 students this past year, totaling 411 graduates, with approximately 175 still participating. This demonstrates that a need has been fulfilled for our health and safety practitioners, who may not meet the criteria for professional certifications, but receive acknowledgement for passing courses from a high quality educational institution. Students also report advancement in their jobs and ability to recognize, report, and correct hazards in the workplace.

6. Lead Renovation, Repair, and Painting (RRP) training, required by US EPA and NC DHHS for renovators to become certified to work with lead-based paint, was initiated in 2010. This training differs from lead abatement training and targets a different audience. NC OSHERC received accreditation by the US EPA and NC DHHS as a training provider and the CE Director as a certified RRP trainer and certified RRP renovator. NC OSHERC is the only training provider accredited in NC to teach the RRP course in Spanish. The CE Director was also accredited as an instructor for Supervisor and Worker Lead Abatement courses. These lead courses are counted under the CE Program and not HST Program courses for NIOSH grant recording purposes. The potential impact on worker safety and health was evident by the students' lack of knowledge of the health hazards of lead dust generated by the renovation of pre-1978 homes that expose workers, homeowners, and families to poisonous lead dust.

7. Contract Courses were offered for Certification Review, IH Sampling, Respiratory Protection, Toxicology, Short Safety Topics, OSHA Recordkeeping, Ergonomics, Safety Auditing; Asbestos training (all levels); and US EPA Lead RRP.

HAZARDOUS SUBSTANCES TRAINING (HST) PROGRAM REPORT

July 1, 2008 – June 30, 2012

The NC OSHERC HST Program at UNC-CH Gillings School of Global Public Health has been serving the educational needs of all disciplines in the Southeast for over 25 years. It is seen as a leading provider of interdisciplinary continuing education in Hazardous Substances Training in the region. The HST Program targets local and state government employees and private practitioners in the Southeast region where work responsibilities may result in exposure to hazardous substances. Faculty reputation and strength is demonstrated by the number of highly recognized academic and non-academic instructors who are associated with the CE Program. Every core program has both types of faculty represented in the CE Programs that have assisted the HST Program in meeting its mission, goals, and objectives. Objectives are set each year and used to measure the success of the HST Program. The objectives include the following:

Objectives were met in the following ways:

1. Train at least 200 people per year.

- Trainees numbered 820 this year in 32 offerings.

2. Increase marketing to HST target audiences by 50% through outreach, advertising, and assisting agencies involved with clean-up and remediation.

    - This was accomplished through Email and letter-writing campaigns to several Hispanic organizations, all Hispanic/Latino Chambers of Commerce in the Southeast, including construction and remediation businesses, and every Department of Environmental Health in the Southeastern states of EPA Region IV.

3. Increase minority enrollment by 3% for each of 5 years.

    - Minority enrollment increased this year by only 1% because of decreased enrollment of those organizations who employ the diverse workforce.

4. Analyze and synthesize HST needs assessments to identify HST course offerings and new development.

    - The Needs Assessments were analyzed to reveal that the top 10 courses requested are offered by the HST Program.

5. Develop 3 online HST courses in the next 5 years based on highest ratings from HST needs assessment data.

    - HST courses are not requested to be offered online. However, the option to offer online courses was investigated. There is a market for awareness-type courses and refreshers, but no other HST offerings. Currrently, UNC is changing to a new method of delivering distance learning from Blackboard to Sakai. Ms. Buckheit has arranged to take a course in its applications and development. However, until that is available in 2012, we will not invest in Blackboard technology as it is being eliminated.

Discussion of Progress and Accomplishments

- Trainees from 7/1/2010 – 6/30/2011 numbered 820 this year in 32 HST offerings. Over the three-year funded project period of July 1, 2008-June 30, 2011, 2066 trainees attended 161 HST courses. Based on the nation's economic situation, we have experienced that employers have frozen or reduced funding for travel and education. We offered many free and reduced-cost HST courses to continue to provide our HST services to those workers in need. This was cost-prohibitive for the HST Program; therefore, until the economy improves, the objective was changed to train 300 workers per year. A regional need has been met with 85% of the students living in the Southeast region. Based on needs assessment and student course evaluations that identified 95% of the students rating the HST Program good to excellent, we have met the students' needs. Diversity in the student population was essentially unchanged with an increase in minority attendance by 1%, and is documented in the following breakdown: White - 84%; Black - 10%; Hispanic - 3%; Asian - 2%; American Indian - 1%.

- Marketing to HST target audiences increased by 50% through outreach, advertising, and assisting agencies involved with clean-up and remediation. The HST Program developed new and continued partnerships, aggressively marketed its courses via Internet and Email for cost-effectiveness, and provided outreach in the form of the following: Advisory Board participation; providing speakers, course materials, and equipment: AV, sampling, and PPE. Outreach was provide to the following:

  - NC Department of Environment and Natural Resources (DENR);
  - NC Office of Public Health Preparedness;
  - 7 regional NC Public Health Response Surveillance Teams (PHRST);
  - NC Department of Health and Human Services (DHHS);
  - UNC's Center for Public Health Preparedness;
  - NC HazMat Regional Response Teams (RRT);
  - NC Association of Hazardous Materials Responders (NCAHMR);
  - Local Emergency Planning Committees (LEPC) for several counties;
  - NC Emergency Management Services (EMS);
  - EMS Rapid Response Teams (EMS RRT)
  - Volunteer and paid fire departments;
  - NC Department of Transportation (DOT);
  - Southeast Association of Fire Chiefs;
  - NC State Bureau of Investigation (SBI);
  - NC State Highway Patrol; and
  - Local health and environmental health departments (Wake, Orange, and Durham).

Minority enrollment increased by 1% this year. Since the objective for the number of trainees has been decreased, the objective to increase minority enrollment has been set for 1% annually. Offers for free training have been accepted by the NC Solid Waste Division, increasing the minority participation. NC OSHERC contacted every state Environmental Health Department and many local agencies in the region. Every Black and Hispanic/Latino Chamber of Commerce in the Southeast and the Governor's Office on Hispanic Affairs was contacted for marketing opportunities to businesses that had employees who needed HST courses and to provide the awareness of NC OSHERC Programs. The HST faculty present awareness courses to communities and specifically for job classifications that typically have a high percentage of minorities, to include solid waste workers and communities near superfund sites with the collaboration with the NC DHHS. Marketing and providing outreach activities with organizations that have members and workers with diverse ethnicity, such as solid waste workers, has helped to identify jobs in which Black and Hispanic workers are employed and offer course

registration waivers to state and local employee groups**.** Several American Indian tribes have been contacted to offer presentations, services, and NC OSHERC Program information.

HST needs assessment data were analyzed annually to identify HST course offerings and new course development. Needs assessment data from 656 surveys revealed that the top ten HST courses requested were already being offered by NC OSHERC. Several methods of HST needs assessments were conducted annually to provide data for analysis and include the following:

- Every HST course includes a student evaluation and needs assessment survey;
- Visitors' surveys from the NIOSH ERC and NC OSHERC exhibit booths at conferences;
- Data from collaborating with professional associations whose members work with hazardous substances and need HST courses;
- Shared data from needs assessments from the other two (Southeast) EPA Region IV HST Programs;
- HST Advisory Board input; and
- Input from HST workers, management, and student comments.

All of these methods are analyzed to determine priorities for a new HST curriculum and course development plans.

- HST activities by the Co-Director have greatly increased. Ms. Buckheit was certified in 40-hour HAZWOPER Technician Level and Incident Command and assisted with teaching the HAZMAT courses during this period. As an Advisory Board member for the NC EMS RRT, she participated with RRT on the 8-hour chemical railroad car spill training with DuPont and the 8-hourTrancaer Anhydrous Ammonia Spill training with the Norfolk Southern Railway and CSX Railroad with over 50 first responders and regional HAZMAT teams. Through these activities, she obtained information on HST educational needs and marketed the HST Programs. She participates on a newly formed "SouthOn", an organized opportunity for the States' Occupational Surveillance Project where exposures to hazardous substances will provide access to new training audiences. She is also on the Advisory Board for the DHHS Pesticide Grant.

- HST Advisory Board added several members: an industrial toxicologist with the Division of Waste Management, Brownfield's Project; a member of the EMS RRT Advisory from the Highway Patrol; and an IH from the Department of Environment and Natural Resources to assist in identifying appropriate training and communities for training.

- Partnerships and collaborations with organizations that require HST training have been developed and are listed in the Marketing section. Based on a comment from the previous proposal stating that HST needed to be more community-based, the HST Director has partnered with NC DHHS in two ways on ATSDR projects:

- Facilitator for Community Communications Task Force for the Toluene Diisocyanate study; and
- Educational resource for another ATSDR grant with NC DHHS providing awareness training and addressing community concerns near Superfund sites.

Another opportunity for collaboration is with the UNC students in Environmental Sciences who have been funded by NIEHS for the Superfund projects in communities. A third method of reaching communities is that Ms. Buckheit has arranged to participate in the EPA Program, The Superfund Job Training Initiative (SJTI). This is an opportunity to work with the EPA in a formal program providing training and technical assistance to communities affected by the Superfund sites.

- Distance learning HST course development is determined by the needs assessments and marketing results, but has been delayed because UNC has changed its application from Blackboard to Sakai and will depend on funding availability for the future. Advanced courses for Hazardous Materials Responders have been requested and collaboration on development is in effect and being discussed with the NC EMS Rapid Response Team (RRT) members. Target audiences are local health departments and first responders in the Southeast region. Currently, Dr. Couch teaches two online HST courses through the UNC Department of Health Policy and Management. They are: 1) Chemical Hazards for First Responders and Emergency Response Planners; and 2) Nuclear and Radiological Hazards for First Responders and Emergency Response Planners.

Thusfar, the only online request has been for an 8-hour HAZMAT Refresher. Based on the type of training for HST, students overwhelmingly request in-person, face-to-face training for other HST offerings. The revision of the online development plan will be to develop one online course and that will be a HST awareness, 8- hour HAZMAT Refresher, or Environmental Risk Assessment for HST course, depending on the current needs assessment data and available funding. The HST Co-Director is registered to take a course on a variety of online training modules, including Sakai.

Program Products

The Telecommunications HazMat Specialist Technician Certificate Program was developed with AT&T HazMat project managers and NC OSHERC HST faculty in 2010 for telecommunications workers who respond in disaster situations as HazMat responders. They must have unique skills as Telecommunications Specialists and the additional training and skills of HAZMAT responders. NC OSHERC graduated 15 AT&T employees from this Certificate Program. Marketing discussions with other telecommunications companies are being conducted. The impact of this training on worker safety and health is that it ensures that the telecommunications workers have the knowledge and skills to protect themselves during disaster situations as they re-establish lines of communication.

New collaborations in HST were developed to increase participation in Kentucky and Tennessee. The instructors have also been brought on as faculty to teach courses at the Winter and Summer Institutes with two new courses: Managing Hazmat Responses in

Healthcare, which did not have enough interest to present the first time, but will be offered again next year, and the new Fundamentals of Environmental Health course, which received excellent evaluations. These courses prepare the worker to also translate their training to others and to protect themselves from exposure to hazardous situations executing their jobs in a safe and healthy manner.

Using the data collected in previous years, three courses were developed and offered. They include: Environmental Risk Assessment; Managing HazMat in Healthcare Settings; and Hurricanes and Disaster Preparedness. Unfortunately, the registrations did not match the needs assessment data and the courses were not held. However, NC OSHERC will offer them in the future as we believe that the potential impact on worker safety and health will be demonstrated through being prepared for these disaster situations.

Based on the new EPA regulation on Lead Renovation, Repair, and Painting (RRP), NC OSHERC is accredited by the US EPA and NC DHHS as a training provider and the HST Director as a certified trainer. The HST Director is accredited as an instructor for Supervisor and Worker Lead courses and certified in RRP. These lead courses are counted under the CE Program courses for NIOSH reporting purposes.

References

Anand B. Joshi, Chapter 14: Fractures and Dislocations of the Cervical Spine, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2010.

Anand B. Joshi, Chapter 14A: Injuries of the Thoracic Spine, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2010.

Anand B. Joshi. Chapter 15: Low Back Injuries, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2011 (in press).

Anderson, A., Mirka, G. A., Joines, S. M B. & Kaber, D. B. (2009). Analysis of alternative keyboards using learning curves. *Human Factors*, 51(1), 35-45.

Anderson, A.P., Meador, K.A., McClure, L.R., Makrozahopoulos, D., Brooks, D.J. & Mirka, G.A. (2007) "A biomechanical analysis of anterior load carriage". *Ergonomics*, 50(12), 2104-2117.

Angelon-Gaetz KA, Richardson DB, Wing S. Inequalities in the nuclear age: Impact of race and gender on radiation exposure at the Savannah River Site (1951-1999). New Solutions: A Journal of Environmental and Occupational Health Policy (2010) 20:195-210

Anthony, Flynn. CFD model for a 3-D inhaling mannequin: verification and validation. Ann Occup Hyg 50(2):157-73, 2006.

Arnold SM, Zarnke RL, Lynn TV, Chimonas MA, Frank A. Public health evaluation of cadmium concentrations in liver and kidney of moose (Alces alces) from four areas of Alaska. Sci Total Environ. 2006 Mar 15;357(1-3):103-11. http://www.ncbi.nlm.nih.gov/pubmed

Ballerino-Regan D, 2010 Revision Author for Chapter 41: Reproductive Disorders and Birth Defects, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2010.

Ballerino-Regan D, Cortez D, Rundman S, Morales E, Turek D, Loftus A, Fagan K. Enhancing Worker Advocacy: OSHA's Outreach to Diverse Worker Populations Poster Presentation Presented at the 1st. National Action Summit for Latino Worker Health and Safety, Houston TX 04/14/2010.

Ballerino-Regan D, Cortez D, Rundman S, Morales E, Turek D, Loftus A, Fagan K. Enhancing Worker Advocacy: OSHA's Outreach to Diverse Worker Populations. Poster and Discussion Session - Strengthening Environmental Justice Research and Decision Making: A Symposium on the Science of Disproportionate Environmental Impacts. Sponsored by US EPA. Washington, DC, 03/18/2010.

Ballerino-Regan D, Kucera K. NORA Pilot Project: Working Restrictions among Duke University Employees during Pregnancy. NCOSHERC, 2011.

Ballerino-Regan, D. and Longmire, A.W. Letter to the Editor – Hydrogen Sulfide. Arch Pathol Lab Med. 2010 Aug;134 (8):1105. PMID: 20670127.

Ballerino-Regan, D. Pre-term Delivery in Tijuana's Working Women Associated Risk Factors a Case Control Study. Presentation at the 2010 American Occupational Health Conference (AOHC-2010) Session 2204 - Current Research in OEM and Resident Research Session. Session Presented on 05/03/2010.

Ballerino-Regan, D. The Medical Side of Reproductive Counseling: After the Teratology Consult for the Pregnant Worker. Presentation at the 2010 Organization of Teratology Information Specialists (OTIS) 23d. Annual Meeting, June29, 2010.

Bender TJ, Beall C, Cheng H, Herrick RF, Kahn AR, Matthews R, Sathiakumar N, Schymura MJ, Stewart JH, Delzell E. Cancer incidence among semiconductor and electronic storage device workers. Occup Environ Med 64(1):30-36, 2007.Beall C,

Bender TJ, Cheng H, Herrick R, Kahn A, Matthews R, Sathiakumar N, Schymura M, Stewart J, Delzell E. Mortality among semiconductor and storage device-manufacturing workers. J Occup Environ Med 47(10):996-1014, 2005.Herrick RF,

Bender TJ, Goepfert PA, El Habib R, Weinhold K, Mulligan MJ; NIAID AIDS vaccine evaluation group. Polymorphisms in HLA class I genes associated with both favorable prognosis of human immunodefieicney virus (HIV) type 1 infection and positive cytotoxic T-lymphocyte responses to ALV AC-HIV recombinant canarypox vaccines. J Virol 75(18):8681-8689, 2001.

Castrodale L, Gessner B, Hammitt L, Chimonas MA, Hennessy T. Invasive early-onset neonatal group B streptococcal cases--Alaska, 2000-2004. Matern Child Health J. 2007 Jan;11(1):91-5. Epub 2006 Dec 16.

Caveney, BJ and Feltner, C. 2011 Revision Author for Chapter 46: Blood bore Pathogens in the Workplace, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2011 (in press).

Ceballos, Fent, Whittaker, Gaines, Thomasen, Flack, Nylander-French, Yost, Reeb-Whitaker. Survey of dermal protection in Washington State collision repair industry. J Occup Environ Hyg, in press.

Ceballos, Whittaker, Yost, Dills, Bello, Thomasen, Nylander-French, Reeb-Whitaker, Peters, Suydam, Weiland. A comparison of analytical methods used for isocyanates. J Anal Methods (submitted).

Cherry AD, Forkner IF, Frederick HJ, Natoli MJ, Schinazi EA, Conard JL, Longphre JP, White W, Frieberger JJ, Stolp BW, Pollock N, Doar PO, Boso AE, Alford EL, Walker AJ, Ma A, Rhodes MA, Moon RE. Predictors of Increased PaCO2 during Immersed Prone Exercise at 4.7 ATA. Journal of Applied Physiology. September 2008.

Cherry AD, Forkner IF, Pollock NW, Freiberger JJ, Stolp BW, Longphre JP, Conard JL, Ma AC, Rhodes MA. Effect of increased respiratory resistance on carbon dioxide levels and hemodynamics in the submerge. Undersea Hyperb Med. 2007; 34(4): 288.

Children's health faculty champions initiative. Environmental Health Perspective. Available online 12/08.

Chimonas MA, Baggett HC, Parkinson AJ, Muth PT, Dunaway E, Gessner BD. Asymptomatic Helicobacter pylori infection and iron deficiency are not associated with decreased growth among Alaska Native children aged 7-11 years. Helicobacter. 2006 Jun;11(3):159-67.

Chimonas MA, Gessner BD. Airborne particulate matter from primarily geologic, non-industrial sources at levels below National Ambient Air Quality Standards is associated with outpatient visits for asthma and quick-relief medication prescriptions among children less

than 20 years old enrolled in Medicaid in Anchorage, Alaska. Environ Res. 2007 Mar;103(3):397-404. Epub 2006 Oct 17.

Chimonas MA, Vaughan GH, Andre Z, Ames JT, Tarling GA, Beard S, Widdowson MA, Cramer E. Passenger behaviors associated with norovirus infection on board a cruise ship-Alaska, May to June 2004. J Travel Med. 2008 May-Jun;15(3):177-83.

Clamann, M., Zhu, B., Beaver, L., Taylor, K., Kaber, D. B. (2010). Comparison of infant car seat grip orientations and lift strategies. Manuscript submitted for publication in *Applied Ergonomics*.

Clamann, M., Zhu, B., Beaver, L., Taylor, K., Kaber, D. B. (2010). Comparison of Infant Car Seat Grip Orientations and Lift Strategies. Manuscript submitted for publication to *Applied Ergonomics*.

Conference Proceedings:

Feltner, C. 2011 Revision Author for Chapter 38: Heart Disease, in Occupational Injuries and Illnesses, Brian J. Caveney, ed. Lexis-Nexis. 2011 (in press).

Fent, Gaines, Thomasen, Flack, Herring, Whittaker, Nylander-French. Quantification and statistical modeling-part I: breathing-zone concentrations of monomeric and polymeric 1,6-hexamethylene diisocyanate. Ann Occup Hyg 53(7):677-89, 2009.

Fent, Jayaraj, Ball, Nylander-French. Quantitative monitoring of dermal and inhalation exposure to 1,6-hexamethylene diisocyanate monomer and oligomers. J Environ Monit 10(4):500-7, 2008.

Fent, Jayaraj, Gold, Ball, Nylander-French. Tape-strip sampling for measuring dermal exposure to 1,6-hexamethylene diisocyanate. Scand J Work Environ Health 32(3):225-40.

Fent, Trelles Gaines, Thomasen, Flack, Herring, Whittaker, Nylander-French. Quantification and statistical modeling-part II: dermal concentrations of monomeric and polymeric 1,6-hexamethylene diisocyanate. Ann Occup Hyg 53(7):691-702, 2009.

Flack, Ball, Nylander-French. Occupational exposure to HDI: progress and challenges in biomarker analysis. J Chromatogr B Analyt Technol Biomed Life Sci 878(27):2635-42, 2010;

Flack, Fent, Gaines, Thomasen, Whittaker, Ball, et al. Hemoglobin adducts in workers exposed to 1,6-hexamethylene diisocyanate. Biomarkers 16(3):261-70, 2011.

Flack, Fent, Trelles Gaines, Thomasen, Whittaker, Ball, et al. Quantitative plasma biomarker analysis in HDI exposure assessment. Ann Occup Hyg 54(1):41-54, 2010;

Flynn, Koto, Fent, Nylander-French. Modeling dermal exposure--an illustration for spray painting applications. J Occup Environ Hyg 3(9):475-80, 2006.

Forkner IF, Pollock NW, Freiberger JJ, Stolp BW, Longphre JP, Conard JL, Natoli MJ, Schinazi EA, Doa. Effect of inspired PO2 on hemodynamics and gas exchange during immersed exercise at 122 fsw. Undersea Hyperb Med. 2006; 35(5): 364-365.

Gaines, Fent, Flack, Thomasen, Ball, et al. Effect of creatinine and specific gravity normalization on urinary biomarker 1,6-hexamethylene diamine. J Environ Monit 12(3):591-9, 2010;

Gaines, Fent, Flack, Thomasen, Ball, Richardson, et al. Urine 1,6-hexamethylene diamine (HDA) levels among workers exposed to 1,6-hexamethylene diisocyanate (HDI). Ann Occup Hyg 54(6):678-91, 2010;

Gaines, Fent, Flack, Thomasen, Whittaker, Nylander-French. Factors affecting variability in the urinary biomarker 1,6-hexamethylene diamine in workers exposed to 1,6-hexamethylene diisocyanate. J Environ Monit 13 (1):119-27, 2011.

Gessner BD, Chimonas MA, Grady SC. It takes a village: community education predicts paediatric lower-respiratory infection risk better than maternal education. J Epidemiol Community Health. 2010 Feb; 64(2):130-5. Epub 2009 Aug 6.

Gessner BD, Chimonas MA. Asthma is associated with preterm birth but not with small for gestational age status among a population-based cohort of Medicaid-enrolled children <10 years of age. Thorax. 2007 Mar;62(3):231-6. Epub 2006 Oct 13.

Gil, G-H., Kaber, D. B., Kim, S-H., Kaufmann, K., Veil, T. & Picciano, P. (2009). Modeling pilot cognitive behavior for predicting performance and workload effects of cockpit automation. In *Proceedings of the 15th Int. Symposium on Aviation Psychology*. Dayton, OH: Wright State University.

Golla J, Nelms J, Taylor R, Mishra S. Pesticide Concentrations in Drinking Water from Farm Homes: Variations between Community Water Supply and Well-Water. Journal of Environmental Science and Engineering (accepted, 2011).

Guevara, E., Im, E., Chee, W. (2007). An exploration of how contextual factors influence the Hispanic cancer patients' attitudes toward Internet cancer support groups (ICSGs). Abstract. Oncology Nursing Forum, 34, 2, 480.

Hamra G, Richardson D, MacLehose R. Markov Chain Monte Carlo: An introduction for epidemiologists. Epidemiology 2011 (under review).

Hamra G, Richardson D, MacLehose RF,Wing SB. "Tritium: Cancer risk and relative biological effectiveness" (in preparation).

Hamra G, Richardson D, MacLehose RF. "Informative priors: a simple approach for utilizing animal and cellular evidence in observational research via order constrained priors" (in preparation).

Hamra G, Richardson DB, Nylander-French L. "Dose reconstruction for an occupational cohort at the Savannah River nuclear facility: Evaluation of a hybrid method." Radiation Protection Dosimetry (2008) 131: 188-197

Hamra, Nylander-French, Richardson: Dose reconstruction for an occupational cohort at the Savannah River nuclear facility: evaluation of a hybrid method. Radiat Prot Dosimetry 131(2):188-97, 2008.

Im, E. O., Chee, W., Guevara, E., Liu, Y., Lim, H. J., Tsai, H., Clark, M., Bender, M., Kim, K. S., Kim, Y. H., & Shin, H. (2009). Gender and Ethnic Differences in Cancer Pain Experience: A Multiethnic Survey in the U.S. Nursing Research, 56(5), 296-306.

Im, E. O., Guevara, E., & Chee, W. (2007). The pain experience of Hispanic patients with cancer in the United States. Oncology Nursing Forum, 34, 2, 861-868.

Im, E., Chee, W., Guevara, E., Liu, Y., Lim, H., Tsai, H. (2007). Gender and ethnicity: are they influencing cancer pain? Abstract. Oncology Nursing Forum, 34, 2, 479.

Im, E.O., Chee, W., Lim, H., Liu, Y., Guevara, E., Kim, K.S. (2007). Patients' attitudes toward Internet cancer support groups. Oncology Nursing Forum, 34, 3, 705-712..

Im, E.O., Chee, W., Liu, Y., Lim, H.J., Guevara, E., Tsai, H., Clark, M., Bender, M., Shin, H., Kim, K.S. & Kim, Y.H. (2007). Characteristics of cancer patients in Internet cancer support groups. CIN: Computers, Informatics, Nursing, 25(6), 334-343.

Im, E.O., Chee, W., Tsai, H., Lim, H., Guevara, E., Liu, Y. (2010). Evaluation criteria for Internet cancer support groups. Computers, Informatics, Nursing, 28(3), 183-188.

Im, E.O., Lee, S.H., Liu, Y., Lim, H., Guevara, E., Chee, W. A. (2009). National online forum on ethnic differences in cancer pain experience. Nursing Research, 58(2), 86-94.

Jiang, Z., Shin, G., Freeman, J.H., Reid , S. & Mirka, G.A. (2005) "A study of lifting tasks performed on laterally slanted ground surfaces", *Ergonomics*, 48(7), 782-795.

Jiang, Z.L., Shu, Y., Drum, J.E, Reid, S. & Mirka, G. A. (2006). Effects of age on muscle activity and upper body kinematics during a repetitive forearm supination task. *International Journal of Industrial Ergonomics*, 36(11), 951-957.

JM Longphre, DJ Darcey. Interesting Case of Lead-poisoning in a Police Officer, Poster Presentation: American College of Occupational Medicine 2008 AOHC Annual Meeting, New York, NY.

Johnson, S. & Ostendorf, J. (2009). "Hispanic employees in the workplace: Higher rates of fatalities. AAOHN Journal, 58(1), 11-16.

Kang-Sickel, Fox, Nam, Jayaraj, Ball, French, Klapper, Gold, Nylander-French. Sarylcysteine-keratin adducts as biomarkers of human dermal exposure to aromatic hydrocarbons. Chem Res Toxicol 21(4):852-8, 2008.

Keil A, S Wing, A Lowman. 2011. Suitability of Public Records for Evaluating Health Effects of Sewage Sludge in North Carolina. North Carolina Medical Journal (in press).

Kim, S-H, Prinzel, L., Kaber, D. B., Alexander, A., Stelzer, E., Kaufmann, K. & Veil, T. (in revision). The effects of HUD configuration on a multidimensional measure of display clutter and pilot performance. Submitted to *Avia. Space & Env. Med*.

Kim, S-H., Kaber, D. B., Kaufmann, K., Veil. T, Alexander, A. L., Stelzer, E. M. & Prinzel, L. J. (2009). Modeling the effects of HUD visual properties and configurations on a multi-dimensional measure of clutter. In *Proceedings of the 15th Int. Symposium on Aviation Psychology*. Dayton, OH: Wright State University.

Kristen Hassmiller Lich, Debbie Travers, Wayne Psek, Morris Weinberger, Karin Yeatts, Winston Liao, Steven J. Lippmann, Levi Njord, Anna Waller. Emergency Department Visits Attributable to Asthma in North Carolina, 2008. North Carolina Medical Journal (Submitted April 12, 2011).

Layne, D., Rogers, B., & Randolph, S.A. (2009). Health and gender comparisons in the long-haul trucking industry: A pilot study. AAOHN Journal, 57(10), 405-413.

Lead exposure from indoor firing ranges among students on shooting teams--Alaska, 2002-2004. Centers for Disease Control and Prevention (CDC). MMWR Morb Mortal Wkly Rep. 2005 Jun 17;54 (23):577-9.Rogers, B. Stiehl, K., Borst, J., Hutchins, S. & Hess, A. (2007). Heat related illnesses: Role of the occupational and environmental health nurse. AAOHN Journal, 55(7), 279-287.

Lee, L. & Kaber, D. B. (2008). Assessing interactive system effectiveness with usability heuristics and markov models of user behavior. In *Proc. of the 52nd Annual Meeting of the Human Factors and Ergonomics Society* (CD-ROM). Santa Monica, CA: Human Factors and Ergonomics Society.

Lippmann S, Richardson DB, Chen JC. Elevated serum liver enzymes and fatty liver changes associated with long driving among taxi drivers. American Journal of Industrial Medicine (accepted, April 2011).

Lipworth L, Bender TJ, Rossi M, Bosetti C, Negri E, Talamini R, Giacosa A, Franceschi S, McLaughlin JK, La Vecchia C. Dietary vitamin D intake and cancers of the colon and rectum: a case-control study in Italy. Nutr Cancer 61(1):70-75, 2009.

Longphre JP, Denoble PJ, Moon RE, Vann RD, Freiberger JJ. First aid normobaric oxygen for the treatment of recreational diving injuries. Undersea Hyperb Med. 2007; 34(1): 43-49.

Longphre JP, Denoble PJ, Moon RE, Vann RD, Freiberger JJ. First aid normobaric oxygen for the treatment of recreational diving injuries. Undersea Hyperb Med. 2007; 34(1): 43-50.

Longphre JP, Freiberger JJ, Denoble PJ, Vann RD. Utility of first aid oxygen prior to recompression treatment for diving injuries. Undersea Hyperb Med. 2005; 32(4): 229.

Longphre JP. First Aid Oxygen Update and the DAN® Oxygen Card, Alert Diver Magazine, Nov / Dec 2006.

Longphre JP. First Aid Surface Oxygen, Is it worth it? Alert Diver Magazine, July/August 2005.

Matthews R, Sathiakumar N, Schymura MJ, Stewart JH, Delzell E. Methodologic issues in follow-up studies of cancer incidence among occupational groups in the United States. Ann Epidemiol 16(3):179-179, 2005. Kaslow RA, Rivers C, Tang J,

Moon R, Longphre, JP.Textbook Chapter: Hyperbaric Medicine Chapter, Civetta, Taylor, & Kirby's Critical Care 4th Ed. 2009.

Moon RE, Forkner IF, Pollock NW, Freiberger JJ, Stolp BW, Longphre JP, Conard JL, Natoli MJ, Schina. The effect of static lung load on hemodynamics and gas exchange during prone immersed exercise. Undersea Hyperb Med. 2007; 34(4): 289.

Moon RE, Longphre JP. Diving. In: Laurent GJ, Shapiro SD, eds. Encyclopedia of Respiratory Medicine. San Diego, CA: Academic Press; 2006: 21-29.

Ostendorf, J., Buckheit, K., and Jones, M. (2010). Employment law and occupational health and safety: The role of the LNC. Legal Nurse Consulting Principles and Practices, 3rd edition. American Association of Legal Nurse Consultants.

Plastaras CT, Joshi AB. The Electro diagnostic Evaluation of Radiculopathy. PM R Clin of NA. 22(1): 59-74

Plastaras CT, Joshi AB. The Electrodiagnostic Evaluation of Neck Pain. PM R Clin of NA. In Press

Pollock NW, Cherry AD, Forkner IF, Natoli MJ, Freiberger JJ, Stolp BW, Longphre JP, Conard JL, Rhode. Comparison of end-tidal versus arterial measures of carbon dioxide during immersed exercise at surfa. Undersea Hyperb Med. 2007; 34(4): 288-289.

Pollock NW, Cherry AD, Forkner IF, Natoli MJ, Frieberger JJ, Stolp BW, Longphre JP, Conard JL, Rhodes MA, Schinazi EA, Doar PO, Boso AE, Alford EL, Walker AJ, Frederick HJ, Moon RE.Comparison of end-tidal versus arterial measures of CO2 during immersed exercise at surface and depth. Undersea and Hyperbaric Medical Society (UHMS) Annual Meeting, 2007

Reeb-Whitaker, Whittaker, Ceballos, Weiland, Flack, Fent, Thomasen, Gaines, Nylander-French. Characterizing airborne isocyanate exposures in the collision repair industry. J Occup Environ Hyg (submitted).

Reid, S.A. & Mirka, G.A. (2007). Learning curve analysis of a patient lift-assist device. *Applied Ergonomics*, 38(5), 765-771.

Richardson DB, Hamra G. "Ionizing radiation and kidney cancer among Japanese atomic bomb survivors." Radiation Research (2010) 173: 837-842

Rogers, B. McCurdy, L., Roberts, J., Slavin, K. Grubb, K. (2008).

Rogers, B. Stiehl, K., Borst, J., Hutchins, S. & Hess, A. (2007). Heat related illnesses: Role of the occupational and environmental health nurse. AAOHN Journal, 55(7), 279-287.

Rogers, B., Dennison, K., Adejou, N., Dowd, S., Uedoi, K. (2010). Part 1: Vaccine cold chain: Proper handling and storage of vaccine. AAOHN Journal, 58(8), 337-344,

Rogers, B., Dennison, K., Adejou, N., Dowd, S., Uedoi, K. (2010). Vaccine cold chain: Part 2: Training personnel and program management. AAOHN Journal, 58(9), 391-401.

Rogers, B., Dennison, K., Adejou, N., Dowd, S., Uedoi, K. Part 1: Vaccine cold chain: Proper handling and storage of vaccine. AAOHN Journal, 58(8) 337-344, 2010.

Rogers, B., Dennison, K., Adejou, N., Dowd, S., Uedoi, K. Vaccine cold chain: Part 2: Training personnel and program management. AAOHN Journal, 58(9), 391-401, 2010.

Rogers, B., Marshall, J., Garth, K., Mopkins, D., Remington, J., Siemering, K., Spivey, J. Focus on the Aging. AAOHN Journal (In Press).

Rogers, B., McCurdy, L., Roberts, J., & Slavin, K. (2008). Evaluation of the National Environmental Education Foundation children's environmental health faculty champions train-the-trainer workshop. Environmental Health Perspective.

Rogers, B., Meyer, D., Atwell, T., Summey, C., Scheessele, D., Ostendorf, J., Randolph, S., and Buckheit, K. What makes a successful hearing conservation program? AAOHN Journal, 57 (8), 1-15.Flack, Goktepe, Ball, Nylander-French: Development and evaluation of quantitative monitoring methods for dermal and inhalation exposure to propiconazole. JEM 10:336-4, 2008.

Rogers, M., Gangakhedkar, S. & Kaber, D. B. (2011). Ergonomic evaluation of emergency veterinary clinic operations. In *Proceedings of the 2011 Applied Ergonomics Conference* (CD-ROM). Orlando, FL (March 21-23): IIE.

Rogers, M., Gangakhedkar, S., & Kaber, D. (2011). KEEPING Fido's helpers HEALTHY. Industrial Engineer: IE, 43(3), 26-31.

Rogers, M., Heath, W., Uy, C., Suresh, S., & Kaber, D. (in review). Effect of multiple displays on task performance in laparoscopic surgical procedures. Submitted to *Applied Ergonomics*.

Rogers, M., Zhang, Y., Kaber, D., Liang, Y., Gangakehedkar, S. (2011). The Effects of Visual and Cognitive Distraction on Driver Situation Awareness. In D. Harris (Ed.): *Engin. Psychol. and Cog. Ergonomics, HCII 2011* (pp. 186–195). Berlin Heidelberg: Springer-Verlag.

Shah V, "Ocular, Musculoskeletal and Ergonomic manifestations among computer professionals in India," Invited Speaker, Applied Ergonomics Conference and Expo 2009, Reno, NV

Shah V, "Ocular, Musculoskeletal and Ergonomic manifestations among computer professional in India" – Poster presentation at the 2009 AOHC / ACOEM annual conference, San Diego, CA.

Shah V, "Practicing Occupational Medicine in USA," Invited Speaker, Basic Concepts in Occupational and Environmental Medicine 2009, New Delhi, India

Shu Y., Drum, J., Southard, S.A., Shin, G. & Mirka, G.A. (2005). The effect of a repetitive, fatiguing lifting task on horizontal ground reaction forces. *Journal of Applied Biomechanics*, 21(3), 260-270.

Song Q, "HIV/AIDS Knowledge, HIV-Risk Related Behaviors and Availability of HIV-Related Health Services Among Female Sex Workers in Seven Provinces of China" (Abstract 803832-Poster P-042). ACOEM 2010 AOHC Conference, Orlando, FL.

Song Q, "Risk Factors for Syphilis and Sexually Transmitted Infections among Female Sex Workers in Seven Provinces of China "(Abstract 800301 - Poster P-041). ACOEM 2010 AOHC Conference, Orlando, FL.

Song Q, "Determinants of mortalities and morbidities of cardiovascular diseases in United States." ATSDR and TN State Department of Public Health Poster Session, 2008 APHA Meeting.

Song Q, "Predicting Infant Mortality Rates in Mississippi Based on Grey Models" Song Q, ATSDR and TN State Department of Public Health Poster Session, 2008 APHA Meeting.

Southard, S.A. & Mirka, G.A. (2007). An evaluation of backpack harness systems in non-neutral torso postures. *Applied Ergonomics*, 38(4), 541-547.

Southard, S.A., Freeman, J.H., Drum, J.E. & Mirka, G.A. (2007). Ergonomic interventions for the reduction of back and shoulder biomechanical loading when weighing calves. *International Journal of Industrial Ergonomics*, 37(2), 103-110.

Steven J. Lippmann, David B. Richardson. Temperature and emergency department visits for heat-related illness in North Carolina, 2007-2008. (in preparation)

Stewart JH, Blicharz D, Beall C, Bender T, Cheng H, Matthews R, Sathiakumar N, Delzell E. Exposure assessment for retrospective follow-up studies of semiconductor- and storage device-manufacturing workers. J Occup Environ Med 47(10):983-985, 2005. Bender TJ, Beall C, Cheng H, Herrick RF, Kahn AR,

Swangnetr, M., Zhu, B., Kaber, D. B. & Taylor, K. (2010). Meta-analysis of user age and service robot configuration effects on human-robot interaction in a healthcare application. In proceedings of the 2010 AAAI Fall Symposium on Dialog with Robots. Arlington, VA: AAAI

Swangnetr, M., Zhu, B., Taylor, K. & Kaber, D. B. (2010). Assessing the effects of humanoid robot features on patient emotion during a medicine delivery task. In Proc. of the 54th Annual Meeting of the Human Factors and Ergonomics Society (CD-ROM). Santa Monica, CA: Human Factors and Ergonomics Society.

Thomasen, Fent, Nylander-French. Development of a sampling patch to measure dermal exposures to monomeric and polymeric 1,6-hexamethylene diisocyanate: a pilot study. J Occup Environ Hyg, in press;

Thomasen, Fent, Reeb-Whitaker, Whittaker, Nylander-French. Field comparison of air sampling methods for monomeric and polymeric 1,6-hexamethylene diisocyanate. J Occup Environ Hyg 8(3): 161-78, 2011;

Thomasen, Nylander-French. Skin penetration patterns of monomeric and polymeric 1,6-hexamethylene diisocyanate. J Environ Monit, submitted.

Uy, C. & Chang, C. (2010). The effect of handle design on the kinetics and kinematics of a pouring task. Manuscript submitted for publication in *Professional Safety*.

Zhang, T., Kaber, D. B., Zhu, B., Swangnetr, M., Hodge, L. & Mosaly, P. (2010). Service robot feature design effects on user perceptions and emotional responses. *International Journal of Intelligent Service Robotics*, 3(2), 73-88.

Zhang, T., Zhu, B., Lee, L. & Kaber, D. B. (2008). Nursing robot interface design and anthropomorphism for patient emotions in patient-robot interaction. In *Proc. of the 4th IEEE Conference on Automation Science and Engineering* (CD-ROM). Washington, DC, August., 24-26, 2008.

Zhang, T., Zhu, B., Lee, L., Swangnetr, M., Mosaly, P. & Kaber, D. (2009). Service robot anthropomorphism and interface design for emotion in human-robot interaction. In *Proc. of the IEA2009 – 17th World Congress on Ergonomics*. Beijing, China: Elsevier.

Zhang, Y., Jin, S., Garner, M., Mosaly, P. & Kaber, D. B. (2009). The effects of aging and cognitive stress disposition on driver situation awareness and performance in hazardous conditions. In *Proc. of the IEA2009 – 17th World Congress on Ergonomics*. Beijing, China: Elsevier.

Table 1: Academic Training Report, 7/1/2007 to 6/30/2012 (by Program Area); NC OSHERC

Program Area	Degree Awarded	How Degree Reads	Total # Applicants to Degree Program	Total # Applicants Admitted to Degree Program	Total # Under Represented Minority Applicants Admitted	# Full-time Students Enrolled	# Full-time NIOSH Supported Trainees	# Part-time Students Enrolled	# Part-time NIOSH Supported Trainees	# Graduated During Reporting Period
OEM	MPH	Master of Public Health	n/a	10	n/a	10	6	0	0	10
		OEM Residency Diploma	n/a	10	n/a	10	6	0	0	10
OHN	MPH	Master of Public Health	n/a	3	n/a	3	3	31	31	13
	MS	Master of Science	n/a	2	n/a	2	2	0	0	0
	PhD	Doctor of Philosophy in Epidemiology	n/a	3	n/a	3	3	0	0	1
	Certificate	OHN Certificate (not funded)	n/a	n/a	n/a	0	0	22	0	18
OES	MS	Master of Science	n/a	220	n/a	220	3	2	0	83
	MSPH	Master of Science in Public Health	n/a	70	n/a	70	6	2	0	36
	MSEE	Master of Science in Environmental Engineering	n/a	111	n/a	111	1	0	0	39
	MPH	Master of Public Health	n/a	18	n/a	18	0	0	0	9
	PhD	Doctor of Philosophy	n/a	322	n/a	322	5	1	0	57
OSE	MIE	Master of Science in Industrial Engineering	n/a	4	n/a	4	0	0	0	2
	MS	Master of Science	n/a	20	n/a	20	7	0	0	18
	PhD	Doctor of Philosophy	n/a	12	n/a	12	0	0	0	5
EPID	MSPH	Master of Science in Public Health	n/a	1	n/a	1	0	0	0	1
	PhD	Doctor of Philosophy	n/a	19	n/a	19	4	0	0	10
TOTAL				825		825	**46**	**58**	**31**	**312**

Total number of all graduates:

OEM is 20; OHN is 32; OES is 224; OSE is 25; EPID is 11; total = 312

[1] Reporting period for renewals is from the start date of prior competing award. New applicants should report past five years.

[2] Full-time and part-time students should include all students in approved programs, regardless of source of support.

[3] OM residents may be double-counted under Masters degree training and post-doctoral training.