DEPARTMENT OF HEALTH & HUMAN SERVICES

Memorandum

Date February 9, 2004

From Principal Engineer, OEP, NIOSH

Subject Final Progress Report for entry into NIOSHTIC2/NTIS for NIOSH Training Grant No. T42 CCT 410423

To Vern P. Anderson, Chief, IRB, EID (C-18)

The enclosed report has been received from the Center Director to document work performed during the specified grant project period. The following information applies to the designated Education and Research Center (ERC):

Title: Occupational Safety and Health Education and Research Center

Center Director: Bonnie Rogers, DrPH
School of Public Health
University of North Carolina
Chapel Hill, NC 27599

Grant No.: T42 CCT 410423

Project Period: 7/1/98 - 6/30/2003

Please place the report in DIDS and I also recommend it for entry into NIOSHTIC2 and submission to NTIS.

Thanks for your assistance.

John T. Talty, P.E., DEE

Enclosure

fpr.unc

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
Program Director

NIOSH Grant # T42/CCT410423 (422952)
7/1/98 – 6/30/03

September 2003

Table of Contents

List of Tables

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 Industrial Hygiene (IH), Occupational Health Nursing (OHN), Occupational Epidemiology (OE), and Health Services Research in Occupational Safety and Health (HSROSH).

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 and the Health Services Research in Occupational Safety and Health Program; Leena Nylander-French, PhD, Industrial Hygiene Program Director; Dana Loomis, PhD, Occupational Epidemiology Program Director; and Larry Hyde, MS, Director of Continuing Education and Outreach and the Hazardous Substance Training Program. All programs are located at the University of North Carolina, Chapel Hill.

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

During the period from July 1, 1998 to June 30, 2003 the UNC ERC graduated a total of 27 students in the core disciplines, and offered over 600 continuing education courses to nearly 11,000 professionals. The ERC remains committed to its mission of providing high quality education for the occupational and safety field.

SIGNIFICANT FINDINGS

The North Carolina Occupational Safety and Health Education and Research Center (NC OSHERC) continues to fulfill its mission by educating occupational health professionals and researchers at all levels. The following significant items are noted:

1. Table 1 presents the 5 year summary for enrollments, support, and graduates for all programs at the NC OSHERC. Enrollments continue to be relatively stable in the Industrial Hygiene (IH) and growing in Occupational Health Nursing (OHN) and Continuing Education (CE) programs. Occupational Epidemiology (OE) and Health Services Research in Occupational Safety and Health (HSROSH) began programs in 2001 and 2000, respectively, so have not yet had program graduates.
2. The NC OSHERC has undergone new leadership transition under the direction of Bonnie Rogers who assumed this role in 2001.
3. The Occupational Health Nursing program has developed and implemented a distance education program in addition to the residential program which has skyrocketed enrollment. Susan Randolph joined the OHN faculty in 2001.
4. The Duke Occupational Medicine program was not renewed and sought status and was approved as a Training Project Grant.
5. A new interdisciplinary course has been added as a NC OSHERC requirement for all NIOSH trainees.
6. The NC OSHERC celebrated its 25th Anniversary with a work and occupational hazard photo display by photo journalist Earl Dotter and held a NORA Symposium at which research was presented by enrolled students.
7. The NC OSHERC took the leadership role in sponsoring and coordinating an international conference with co-sponsors the International Congress on Occupational Health, Johns Hopkins School of Public Health, and NIOSH. The conference exceeded enrollment predictions by 100% with >300 participants from more than 30 countries worldwide.
8. The principal sources of funding for faculty and staff in all program areas remain state funds and research grants.
9. NIOSH support for students has been extremely important and without stipends and tuition awards, it is unlikely many of the students would make application.

Table 1
Enrollments, Graduates, CE Summaries 1998-2003

Core Enrollment		Total
	IH	53
	OHN	37
	OE	10
	HSROSH	2
Trainees Supported		
	IH	27
	OHN	37 (full/partial)
	OE	2
	HSROSH	2
Number of Graduates		
	IH	12
	OHN	15
	OE	0*
	HSROSH	0*
Continuing Education (enrollments)		
	IH	1,653
	OHN	1,474
	OE	452
	Safety	1,671
	Other	5,602
	Total	10,852
Continuing Education (courses)		
	IH	133
	OHN	24
	OE	24
	Safety	137
	Other	295
	Total	613

*Programs started 2000,2001 so insufficient time for graduates to be produced.

NARRATIVE

INDUSTRIAL HYGIENE

The mission of the Occupational Hygiene Training Program is to educate and train highly qualified scientists in both the practical and theoretical application of the principles of research and the practice of occupational hygiene for mitigating exposure and disease. The Program encompasses a full range of applications in occupational hygiene, including sample collection, analysis, statistical modeling, and interpretation of exposure data in order to investigate the relationships between exposure and development of disease. The location of the program within the Department of Environmental Sciences and Engineering in the School of Public Health provides unique resources and interdisciplinary opportunities for education of the individuals needed to develop cost-effective, reliable exposure assessment methods and control solutions, which are needed by today's rapidly changing industry. The industrial hygiene program at the UNC-CH is well positioned to provide research training at both doctoral and Master's level in the areas of exposure assessment and control technology for human exposures to both airborne and dermal hazards. The program has an extremely strong and broad exposure assessment group, which provides unique and innovative methods and the necessary statistical tools to evaluate exposures. Furthermore, this group has an important link to the Epidemiology and Biostatistics departments, which provides the knowledge base needed to investigate the level of risk associated with a given exposure and how economic control of such risk is achieved. These fundamental questions are the heart of the current debate over environmental and occupational exposure levels and the cost associated with achieving acceptable exposure levels.

With the leadership of the new Chair of the Department of the Environmental Sciences and Engineering, major changes have occurred in the Department during the past three years. The program areas were disseminated and only two courses were assigned as required. This arrangement allows the students and faculty to design more individually appropriate study and research program as well as more possibilities for collaboration between the different disciplines in the Department. Due to these administrative changes in the Department, the research qualifications and strength of our faculty and research program, which continues to make the UNC industrial hygiene research program one of the best in the world, as well as due to the pressing need for the education of PhD level occupational health professionals, our program is concentrating on training the academic and research occupational health professionals of the future. The most effort is given to the doctoral level training. However, the training at the Master's level remains important in the areas of exposure assessment and control technology.

At the doctoral level, industrial hygiene training and research provide the foundation for the development of new methods for exposure assessment and control and prepare

scientists for research and teaching careers in occupational health and safety. These individuals will contribute significant knowledge to the field and be prepared to conduct original ongoing research at academic institutions, government agencies, corporations, or serve as specialized consultants.

The training objectives for the Master's program remain the education of highly qualified professional industrial hygienists with strength in the areas of exposure assessment and control technology. Faculty are shown in Table 2. Our goal is to develop the communication skills, knowledge base, and critical thinking capabilities that have been consistently identified by industry, government, and labor as the tools needed for success at the professional level. The Master's degree in industrial hygiene provides the basic training needed for an individual to function as a professional of occupational health and safety within a corporation, a government agency, or a labor organization as well as to prepare the individual for further training in the scientific and research area. The Master of Science in Environmental Engineering (MSEE) degree represents a unique opportunity for research and training in the engineering control aspects of occupational health. The industrial hygiene program is accredited by the ABET through the end of 2002 for the MS and MSPH degrees and will go through an interim review this summer. This reaccreditation would be valid until the end of 2005. MSEE degree is also accredited by ABET through the end of 2006 and is one of the few such engineering programs within a School of Public Health.

All three MS-degree programs require 2 years of course work and submission of a master's technical report or thesis, which describes a relevant research project, and an oral defense/presentation of the work before a faculty committee. Appropriate projects involve laboratory research, development of theory, and/or fieldwork. Typically, the research project takes about half the student's time during the second year of graduate study. Each student project is under direct supervision of a faculty member in the industrial hygiene focus area. In addition, two other faculty members serve on the student's research committee and help with evaluation of the academic progress. Successful projects result in presentations at annual meetings, and publications in relevant scientific journals. The Masters project teaches the student to develop independent thoughts and to express them in a concise, straightforward manner and the oral presentation develops communications skills. Abilities in these areas will serve the student well whatever his or her duties may ultimately be.

Course Requirements and Electives for Industrial-Hygiene Master's Students

The course requirements of master's students in the industrial hygiene focus area are provided below and shown on Table 3. These students take the required core courses for the School of Public Health and the Department of Environmental Sciences and Engineering. The Department requires a seminar (ENVR 103) and a Unifying

Table 2
Industrial Hygiene Faculty

Faculty Member	Position	Area of Competence
Core Faculty		
Leena A. Nylander-French	Assistant Professor	Exposure Assessment, Dermal Exposure, Biological Monitoring
Michael R. Flynn	Professor	Ventilation, Mathematical Modeling of Exposure
Don Fox	Professor	Air Chemistry, Exposures
Richard Kamens	Professor	Indoor Air, Exposures to PAH's
David Leith	Professor	Engineering Controls, Aerosol Physics
Stephen M. Rappaport	Professor	Exposure Assessment, Biological Monitoring
Parker C. Reist	Professor	Aerosol Science
Marc Serre	Assistant Professor	Exposure Assessment, Mathematical Modeling of Exposure
Lori Todd	Associate Professor	Exposure Assessment, Community Outreach
Joint and Adjunct Faculty		
Doug Crawford-Brown	Professor	Risk Assessment and Radiological Health, Department of Environmental Sciences and Engineering, UNC
John Dement	Adjunct Associate Professor	Exposure Assessment, Hazardous Materials; Duke University Medical Center, Durham, NC
David Ensor	Adjunct Professor	Aerosol Physics; Research Triangle Institute, RTP, NC
Ray Hackney	Adjunct Lecturer	Biohazards and Industrial Hygiene; Health & Safety Office, UNC
Tim Hitchcock	Adjunct Associate Professor	Ergonomics & Radiological Hygiene; IBM, RTP, NC
Dana Loomis	Joint Professor	Occupational Epidemiology; Department of Epidemiology, UNC
Woodhall Stopford	Adjunct Assistant Professor	Occupational Medicine; Duke University, Durham, NC
Don Tyndall	Adjunct Professor	Radiological Health; Diagnostic Science and General Dentistry, UNC
Russel Wiener	Adjunct Assistant Professor	Aerosol Physics; USEPA Environmental Monitoring Systems Lab, RTP, NC
Nelson Couch	Adjunct Associate Professor	Radiological Hygiene; Radiation Safety Office, NCSU, Raleigh, NC

Table 3
Industrial Hygiene Courses

Number	Title	Credit	Semester	Faculty
ENVR 103	Seminar Series	1	Both	ENVR Faculty
ENVR 104	Unifying Concepts	3	Fall	Miller
BIOS 145	Principles of Experimental Analysis	3	Both	Biostatistics faculty
EPID 160	Principles of Epidemiology	4	Spring	Epidemiology faculty
ENVR 111	Laboratory Techniques and Field Measurements	3	Fall	Nylander-French, Weinberg, Whalen
ENVR 116	Introduction to Aerosol Science	4	Fall	Leith
ENVR 116L	Aerosol Science Laboratory (alternate years)	2	Fall	Reist
ENVR 130	Health Effects of Environmental Agents, OR	3	Fall	Ball, Nylander-French
ENVR 135	Industrial Toxicology, OR	2	Spring	Stopford
ENVR 175	Environmental Risk Assessment, OR	3	Spring	Crawford-Brown
ENVR 232	Health Effects of Outdoor and Indoor Air Pollution	3	Fall	Hazucha
ENVR 134	Air and Industrial Hygiene	3	Fall	Fox, Todd
ENVR 136	Radiation Hazards Evaluation I	3	Spring	Couch
ENVR 137	Occupational Safety and Ergonomics	3	Fall	ENVR Faculty
ENVR 138	Health Hazards of Industrial Operations	3	Spring	Flynn
ENVR 139	Theory and Practice of Exposure Evaluation	3	Spring	Todd
ENVR 250	Principles of Industrial Ventilation	3	Fall	Flynn
ENVR 392	Master's Technical Report, OR	3	Both	Core Faculty
ENVR 393	Master's Thesis	3	Both	Core Faculty

Advanced Courses:

Number	Title	Credit	Semester	Faculty
ENVR 233	Biological Monitoring	2	Spring	Nylander-French
ENVR 250D	Ventilation Design Problem	1	Fall	Flynn
ENVR 251	Air Pollution Control	3	Spring	Leith
ENVR 260	Micro-Environmental Air Flow Modeling (odd years)	3	Fall	Flynn
ENVR 276	Advanced Methods of Exposure Assessment (even years)	3	Spring	Rappaport
ENVR 290	Environmental Law	3	Fall	Heath
ENVR 167	Advanced Functions of Temporal GIS	3	Fall	Serre
ENVR 275	Model-Based Exposure Mapping and Risk Assessment	3	Spring	Serre
MAE 510	Effects of Noise and Vibration on Man (NCSU)	2	Fall	
MAE 514	Noise and Vibration Control (NCSU)	3	Spring	

Concepts course (ENVR 104) designed to expose all ENVR students to the fundamental principles common to the field. In addition, students take enough elective courses to bring the total number of credits earned to a minimum of thirty semester hours.

We also encourage our students to enroll in continuing education courses offered through the ERC that cover materials related to professional practice not presented through our regular academic courses. In order to take better advantage of the excellent collection of CE courses in industrial hygiene, which are offered by our ERC, the ARIH faculty recently made it possible for students to receive academic credit, a maximum of 3 credit hours, for attending CE courses. A formula of one credit hour per 15 contact hours was agreed upon in keeping with university guidelines. Students in the industrial-hygiene track can also take courses at Duke University (e.g., occupational diseases, biohazards) or at North Carolina State University (e.g., noise, ergonomics and safety) through a reciprocity agreement we have with those schools.

Several first-year industrial hygiene students accept internships for the summer with major companies, IBM, GlaxoSmithKline, Merck, and Amoco are the recent examples. Although not a formal requirement, this internship program has long been popular with the students since it offers direct paid experience, and also by the employers, many of whom use the program as a tool for recruiting full time employees. Often these internships serve as the basis of the student's technical report and the faculty advisor can monitor their progress during the summer, and evaluate the potential for future beneficial internships with that company.

Students in the MSEE program must take ENVR 250 Principles of Industrial Ventilation, ENVR 250D Ventilation Design Problem, and ENVR 251 Air Pollution Control. Students in the MSPH program must take two general public health courses, one from the Department of Health Behavior and Health Education (HBHE 131 or alternative) and one from the Department of Health Policy and Administration (HPAA 220 or alternative). In addition to the core courses listed below, most students take several advanced courses (listed below the core courses). Students are encouraged to take courses taught by faculty outside the industrial hygiene focus area faculty after consultation with their faculty advisor.

All NIOSH funded students are required to take PUBH 285: Interdisciplinary Approaches in Occupational Health, attend a minimum number of interdisciplinary seminars, and attend an NC OSHERC orientation meeting. Other interdisciplinary activities noted in industrial hygiene include students taking courses with occupational health nursing students, safety students, and physicians in toxicology, industrial hygiene, and safety/ergonomics courses and working on projects together. Students also engage in joint collaborative research. For example, IH, OHN and OE students worked together on the Housekeeper's Health Study conducting 15 campus-wide walk-throughs of buildings to identify hazards and observe working conditions.

Research Training in Doctoral and Post-doctoral Level

The goal of the Research Training program is twofold. First, to produce highly qualified PhD's who will contribute significant knowledge to the field, and be prepared to conduct original ongoing research at academic institutions, government agencies, corporations, or serve as specialized consultants. It is our sincere desire to produce the hygiene faculty of the future. Although there are few formal course requirements for the PhD degree, actual courses required are determined by the research committee, students in this program typically spend between one and two years in course-work prior to taking their qualifying examinations. The examinations include both written and oral components and cover basic knowledge of the principles of industrial hygiene as well as a proposal for a research project. The student is then responsible for conducting an independent research project, which contains sufficient new information for several peer-reviewed publications. The research focus area in industrial hygiene is: Exposure Assessment and Engineering Control of Airborne and Dermal Contaminants.

Second, we seek to provide recent PhD's. the opportunity for postdoctoral training in our laboratories. This is particularly important in light of the complexities associated with our highly technological world. Particularly, post-doctoral training in dermal exposure is a new and critical area of research and addresses current National Institute for Occupational Safety and Health (NIOSH) program priority area "Research Tools and Approaches: Exposure Assessment Methods", which is identified in the National Occupational Research Agenda (NORA). In addition, the Exposure Modeling and Control (EMC) Center has been successful. The EMC center is responsive to several NORA priority areas including Intervention Effectiveness Research, Control Technology, and Emerging Technology, as well as providing a new prospective exposure assessment tool to help with Pre-Manufacture Notification (PMN) questions. This center seeks to expand doctoral and post-doctoral training in exposure modeling for use in engineering control decisions and in modeling exposures using numerical and laboratory techniques.

Expertise in the areas of exposure assessment and engineering control has established UNC's industrial hygiene program with the theme "Exposure Assessment and Engineering Control of Airborne and Dermal Contaminants". We believe that this program provides a unique and distinctive contribution to the field of industrial hygiene at both the Ph.D. and Master's level. In particular, we propose to provide trainees with research experience in conducting field studies to develop exposure assessment methods, to investigate exposure-dose-response relationships, and to calibrate models for the optimal control of exposure. We believe that by blending experimental studies in our laboratories, which develop the theory and appropriate models, with empirical studies in the field, which provide the data to validate the models, trainees will obtain truly rewarding experiences. The strength on the quantitative and engineering side of industrial hygiene provides our students with skills not available in other programs (e.g.,

access to computational fluid dynamics packages and supercomputers, advanced aerosol and radiation measurement techniques, and unparalleled air engineering facilities). These skills will prove useful for addressing the pressing national and regional issues of controlling exposures economically.

OCCUPATIONAL HEALTH NURSING

The Master of Public Health (MPH) and the Master of Science (MS) degrees with specialization in Occupational Health Nursing are offered in the Public Health Leadership Program although the MS degree is planned for phase out because of declining enrollment. The MPH program requires a minimum of 39 credits of which 20% may be transfer-in credits as is permitted for all students by the Graduate School. This program is taken on-campus and through distance education (described later). The MPH program in Occupational Health Nursing prepares occupational health nurse specialists for positions in leadership, program planning and evaluation, or management of occupational health nursing programs. The program leading to the MS degree prepares graduates in program planning and evaluation; however, emphasis is on the development of research skills as beginning researchers. The MPH student can complete the degree in 11/2 years while two years of full-time study is required for the MS student. Students have 5 years to complete the program.

The goal of the Occupational Health Nursing (OHN) Program is to provide education, training, and research experience where appropriate to occupational health nursing professionals so as to transfer learned knowledge to promote and protect the health of the workforce. Program objectives include:

1. Provide MPH training both on-campus and via distance education and MS degree education residentially on-campus.
2. Provide interdisciplinary learning opportunities and experiences.
3. Provide integrated/applied learning through practicum experiences.
4. Provide trainees with opportunities for scholarly demonstration of knowledge learned (e.g., master's paper publications, presentations).
5. Admit 4-6 trainees/year.
6. Offer continuing education/outreach to the occupational safety and health community.

Trainees are prepared to take leadership/management positions in industry, government, and other occupational health settings, act as consultants to business, industry, and government, and provide program planning and evaluation expertise.

The OHN specialty is broad and dynamic requiring a sound foundation in the sciences of public health, occupational health, and nursing within an interdisciplinary framework which is an essential integrated building block. The master's curriculum content in OHN contains three components: the public health sciences; the occupational

health nursing core studies and OHN functional role courses, and practicum; and the occupational health sciences interdisciplinary cognates. The illustrative programs of study for MPH and MS degree programs are shown in Tables 4, 5, and 6. All students in the MPH or the MS degree program take the same core courses in the public health sciences, excepting coursework in health services administration and behavioral sciences, which is only for the MPH students. All OHN students take the occupational health nursing core studies, functional role, and occupational health cognates. MS students are required to take research methods/statistics coursework for research skills development.

Specialization in occupational health nursing requires foundational courses from the public health sciences, specifically epidemiology (EPID 160), biostatistics (BIOS 101/110), health administration (HPAA 119), environmental sciences (ENVR 101), and behavioral sciences (HBHE 131). Coursework in epidemiology provides a foundation for epidemiological inquiry; biostatistics provides for application of statistics in the planning, coordination and analysis of projects, research, and data; environmental sciences coursework introduces the student to basic concepts in environmental health, e.g., air and water pollution, food safety, hazardous substance exposure, and environmental policy and management; behavioral sciences addresses social and behavioral theories applied to health motivating; and coursework in health policy/administration focuses on organizational and human resources management.

Through a theoretical and conceptual framework, the OHN Program prepares the student as a specialist in occupational health nursing. OHN course content uses an occupational health nursing model based on system's theory developed by this director/author to emphasize OHN roles, worksite assessment, interdisciplinary functioning, health promotion and prevention, management, program planning and administration including cost-benefit/effectiveness in occupational settings. The OHN courses (PHNU 281, PHNU 282) and practica (PHNU 283, PHNU 284, and PHNU 396) are sequenced so that students begin by learning theories, concepts and principles in occupational health nursing and then applying these at the worksite, i.e., assess work-related health problems, and plan, implement, and evaluate occupational health programs/projects. Students have a variety of applied learning experiences e.g. walkthroughs, health promotion projects, and seminar leadership and teaching opportunities including a presentation and discussion of each student's individual philosophy of occupational health nursing and a jointly prepared and presented topic of occupational health nursing interest. For example, students this year presented topics on bioterrorism and genetics and the occupational health nursing impact. Students also conduct joint walk-throughs in the context of a system's analysis approach making joint presentations and providing an individually written paper.

Table 4
MPH Occupational Health Nursing Program
Sample Guide for On Campus Education Form

Year 1 (see note:)

Summer	Fall	Spring
PHNU 281 (3)[2]	EPID 160 (3)	ENVR 101 (2)
	BIOS 101/110 (3)	
	HPAA 119 (2)	
	ENVR 137 (3)	
	PHNU 283 (2)*	

Year 2

Summer	Fall	Spring
PHNU 282 (3)[2]	PUBH 248 (2)[1]	HBHE 131 (2)
PHNU 396 (3)	PUBH 249 (2)[1]	ENVR 101 (2)
	ENVR 134/138(3)/	ENVR 135 (2)
	PUBH 240 (2)	ENVR 100 (1)[3]
PHNU 244 (2)	PHNU 392 (3)	*(part of ENVR 135)*
		PHNU 284 (2)*
		PUBH 285 (2)

Minimum Credits Required for Graduation = 39

1 = internet based
2 = on campus course (2 1/2 weeks)
3 = optional

Certifications – anytime
Spirometry
Hearing Conservation
CPR Instructor

Note:

- *This format is fluid and is constructed as a guide to which course offerings may vary in the semester in which they are offered.*
- *This program of study can be completed in approximately 1 ½ - 2 years as outlined above. However, you have five years from admission within which the program must be completed.*
- *Independent study/transfer in credit (20% of total program credits may be transferred in with approval).*

Number	Hours	Title
BIOS 101/110	3hr.	Fundamentals of Biostatistics/Principles of Statistical Inference
ENVR 100[3]	1hr.	Industrial Toxicology, *extra credit*[3]
ENVR 101	2hr.	Environmental Health
ENVR 134/138	3hr.	Air and Industrial Hygiene/Health Hazards of Industrial Operations
ENVR 135	2hr.	Industrial Toxicology
ENVR 137	3hr.	Occupational Safety and Ergonomics
EPID 160	3hr.	Principles of Epidemiology
HBHE 131	2hr.	Social and Behavioral Sciences in Public Health
HPAA 119	2hr.	Evolution, Organization, and Financing of the US Health System
PHNU 281	3hr.	Occupational Health Nursing I
PHNU 282	3hr.	Occupational Health Nursing II

PHNU 283*	2hr.	Occupational Health Nursing Field Practicum I
PHNU 284*	2hr.	Occupational Health Nursing Field Practicum II
PHNU 392	3hr.	Master's Paper
PHNU 396	3hr.	Field Practice in Public Health
PUBH 240	2hr.	Fundamentals of Industrial Hygiene
PUBH 244	2hr.	Nursing Roles and Functions
PUBH 248	2hr.	Policy Development
PUBH 249	2hr.	Program Evaluation
PUBH 285	2hr.	Interdisciplinary Approaches in Occupational Health

* **PHNU 283/284 required for students without occupational health nursing experience.**

Table 5
Occupational Health Nursing Courses/Program of Study

MPH Degree
Occupational Health Nursing Subspecialty

Name:_____
Degree:_____
Last Updated:_____

Minimum of 39 credits to graduate

Complete by checking box and writing semester/year.

School of Public Health Core: (12 credits)

- ☐ EPID 160 (3)
- ☐ BIOS 101 (3)
- ☐ ENVR 101 (2)
- ☐ HPAA 119 (or approved equivalent) (2)
- ☐ HBHE 131 (2)

Occupational Health Course Cognates (9-11 credits)

- ☐ ENVR 135 (2)
- ☐ ENVR 100 (1) (Part of ENVR 135)**
- ☐ ENVR 137 (3)
- ☐ ENVR 134/138 (3)/PUBH 240 (2)
- ☐ PUBH 285 (2)

Public Health/Occupational Health Nursing Core: (18-22 credits)

- ☐ PHNU 281 (3)
- ☐ PHNU 282 (3)
- ☐ PHNU 283* (2)
- ☐ PHNU 284* (2)
- ☐ PUBH 244 (2)
- ☐ PUBH 248 (2), or equivalent
- ☐ PUBH 249 (2), or equivalent
- ☐ PHNU 392 (3)
- ☐ PHNU 396 (3)

Certifications:

Spirometry
Hearing Conservation
Cardiopulmonary Resuscitation (CPR) Instructor

* For OHN Students without occupational health nursing experience

** Students may elect to add 1 credit (ENVR 100)

Table 6
Occupational Health Nursing Courses/Program of Study

MS Degree
Occupational Health Nursing Subspecialty

Minimum of 45 credits to graduate

Name:_____
Degree:_____
Last Updated:_____

Complete by checking box and writing semester/year.

School of Public Health Core: (8 credits)

- ☐ EPID 160 (3)
- ☐ BIOS 110 (3)
- ☐ ENVR 101 (2)

Public Health/Occupational Health Nursing Core: (19-23 credits)

- ☐ PHNU 281 (3)
- ☐ PHNU 282 (3)
- ☐ PHNU 283 *(2)
- ☐ PHNU 284 *(2)
- ☐ PHNU 393 (3-9)
- ☐ PHNU 396 (3)
- ☐ PUBH 244 (2)
- ☐ PUBH 248 (2)
- ☐ HBHE 250 (3)

Occupational Health Course Cognates (10-11 credits)

- ☐ ENVR 135 (2)
- ☐ ENVR 100 (1) (Part of ENVR 135)**
  - ☐ ENVR 137 (3)
- ☐ ENVR 134/138 (3)/PUBH 240 (2)
  - ☐ PUBH 285 (2)

Electives: (8-12 credits)

- ☐ ____ ☐ ____
- ☐ ____ ☐ ____

Certifications:

Spirometry
Hearing Conservation
Cardiopulmonary Resuscitation (CPR) Instructor

* For OHN Students without occupational health nursing experience

** Students may elect to add 1 credit (ENVR 100)

PHNU 283/284 practica are concurrent during the academic semesters and are required for students without OHN experience. The concentrated field practicum, PHNU 396 (5-8 weeks), is required of all students, and enables them to develop and implement advanced OHN practice projects and synthesize the practice within their functional roles. Occupational health nursing students complete PHNU 248 Policy Development which helps to increase students' knowledge and skill related to administration, management, and policy impact. This helps to fulfill a program goal of enhancing students' skills in leadership roles in public health and occupational health nursing. Health care financing, cost containment, and the economic impact of health care within an ethical framework is emphasized throughout the program. Role development is fostered by the attitudes, commitment, expertise, and activities of the faculty and preceptors, who serve as role models and students will also begin taking in Spring/Summer 03, PHNU 244, Roles in Public Health Nursing.

The research training program was NIOSH-approved in May 1997, however, to date we have had only three occupational health nursing students enrolled in the program. One student has graduated, one student decided to transfer to the occupational epidemiology program to devote a sole focus in that area, and one student remains enrolled thus making it difficult to develop/maintain a cadre of occupational health nursing students. While we continue to get inquiries for the PhD program, most inquiries are for a distance education option. Faculty provide teaching, advisement, research experiences, and service opportunities for students. Faculty are listed in Table 7.

Table 7
Faculty, Occupational Health Nursing Program

CORE FACULTY	COMPETENCE AREA
Bonnie Rogers, DrPH, COHN-S, LNCC, FAAN	Occupational Health Nursing, Epidemiology, Ethics, Health Care Worker Hazards
Judith Ostendorf, MPH, COHN-S	Occupational Health Nursing, Ergonomics
Susan Randolph, MSN, COHN-S	Occupational Health Nursing, Agriculture
Lorraine Johnson, RN, PhD	Public Health Nursing, Skin Disease
Dana Loomis, PhD	Epidemiology
SUPPORTING FACULTY	
Connie Mullinex, PhD, RN	Policy Analysis
Carol Epling, MD	Occupational Medicine
Carol Runyan, PhD	Health Behavior
ADJUNCT FACULTY	
Elise Handleman, MEd, COHN-S	Occupational Health Nursing, Ergonomics
Judith Holder, PhD	Occupational Mental Health
Kathleen Buckheit, MPH, COHN-S	Occupational Health Nursing, Ergonomics
Karen Mastroianni, MPH, COHN-S	Occupational Health Nursing, Health Education
Kay Campbell, EdD, COHN-S	Occupational Health Nursing, Health Promotion
Elizabeth Lawhorn, MSN, COHN-S, CCM	Occupational Health Nursing, Health Promotion
Grace Rome Schnackenberg, MS, COHN-S, CCM	Occupational Health Nursing, Counseling
Ruth Barlow, MS, COHN-S, CCM	Occupational Health Nursing, Case Management
Sam Moon, MD, MPH	Occupational Medicine, Disability Management, Ergonomics
Patricia Travers, MS, COHN-S	Occupational Health Nursing, Disability Management
Jon Wallace, MBA, CSP	Occupational Safety

OCCUPATIONAL EPIDEMIOLOGY

Occupational Epidemiology is a new component program that joined the UNC ERC in 2001. The Program's mission is to train highly-qualified scientists who will develop and apply the theory, methods and substance of epidemiology to protect workers' safety and health. Doctoral-level training to prepare scientists for careers in occupational health and safety research and teaching are emphasized.

Occupational epidemiology is the study of the distribution and determinants of disease and injury as they relate to work, and their means of prevention. While it is a new component of the OSHERC, occupational epidemiology has been an important field of research and teaching at the University for over 20 years, and considerable strength already exists in this area. The UNC program in Occupational Epidemiology encompasses the full range of traditional applications of epidemiology in occupational health, such as surveillance, etiologic research, and quantification of exposure-disease relations, plus a focus on quantitative methods and innovative applications to the study of social and economic aspects of work and their effects on health. Another distinctive feature of the Program is that it will train researchers in occupational injury epidemiology, as well as in classical areas of occupational epidemiology that typically focus on chronic diseases. This opportunity for training in occupational injury epidemiology complements and reinforces the ergonomics and safety program that is joining the ERC this year. The areas of focus within the Occupational Epidemiology program touch on several of the priority areas embodied in the National Occupational Research Agenda (NORA).

Research training is the centerpiece of the Occupational Epidemiology program. Its primary goals are to train researchers with a high level of intellectual and technical skill who will engage with the most challenging occupational health problems from positions in academia, government, and the private sector, and to prepare the occupational epidemiology faculty of the future, who will educate the following generation of researchers and practitioners. Research training is provided at the pre-doctoral level and leads to the PhD degree.

Programs of Study

Because the backgrounds and interests of trainees are diverse, programs of study are individualized. Beyond the formal requirements, students and their advisors collaborate to tailor individual programs of study centered on the student's area of research. Doctoral students typically take more than the required number of courses by selecting--in consultation with their advisors--additional courses that are directly related to their research areas and career plans.

Epidemiology doctoral students are expected to have an understanding of the major conditions that influence the health of the public, and are strongly encouraged to take substantive epidemiology courses outside their specialty area. Most doctoral students therefore take courses related to major health outcomes, such as Cardiovascular Disease Epidemiology (EPID 256), Cancer Epidemiology (EPID 233), or Infectious Disease Epidemiology (EPID 218), and many also take Perinatal Epidemiology (EPID 219) or Injury as a Public Health Problem (EPID 125). Doctoral students are strongly encouraged to take additional courses in Biostatistics, as well. Many take Analysis of

Categorical Data (BIOS 165), and the most quantitatively advanced may choose Probability and Statistical Inference I and II (BIOS 160 and 161). In addition, all students in the Environmental, Occupational, and Injury Epidemiology Program are advised to take at least two courses outside the Department in areas related to their field of specialization. These are typically in environmental sciences, but students may choose from a list of recommended courses covering such diverse areas as toxicology, demography and medical geography.

For NIOSH Occupational Epidemiology trainees, courses beyond the formal requirements will be recommended on an individual basis, according to their research areas and career goals. Recommendations for coursework are made by the faculty advisor, and needs for additional coursework are formally evaluated during an Intradepartmental Review that usually takes place during the second year of the doctoral program. For most Occupational Epidemiology trainees, the courses recommended would be in epidemiology, environmental sciences, or biostatistics. Students pursuing certain research areas might be directed to courses in other disciplines, like behavioral sciences or public policy, however. To show the potential diversity of programs, students interested in occupational injury might be encouraged to take Principles of Injury Prevention and Control (EPID 125) and Industrial Safety and Ergonomics (ENVR 147) to supplement the required sequence. Those interested in exposure assessment methods might be encouraged to take Theory and Practice of Exposure Evaluation (ENVR 242) and Biochemical Epidemiology (EPID 223), while students pursuing research in occupational cancer might be directed toward Cancer Epidemiology (EPID 233) and Chemical Carcinogenesis (ENVR 291). As noted above, all trainees will take Interdisciplinary Approaches to Occupational Health (PUBH 285).

Courses for a typical Occupational Epidemiology trainee with a Master's degree are shown in Tables 8 and 9. Most trainees are expected to follow a similar pathway, since, as noted above, they would enter the program with either a Master's from another institution or after completion of the MSPH at UNC.

Because the Program is housed in a large, established epidemiology department in a leading school of public health, trainees will have the benefit of access to a wide array of courses and research opportunities in epidemiology, environmental health sciences, and other public health disciplines. Within occupational epidemiology, the diverse interests of our program faculty provide trainees with a broad understanding of the field, as well as a number of potential areas for specialization. Our faculty's interests embrace several NORA priority research areas, including fertility and pregnancy abnormalities, musculoskeletal disorders, traumatic injuries, special populations at risk, work organization, and research methods in cancer, risk assessment, and exposure assessment. Despite our breadth, however, we can identify three areas that particularly stand out for their unique approach or concentration of expertise.

Two areas where the UNC program makes a special contribution to occupational epidemiology are in research on occupation and reproduction and the study of occupational injuries, both described above. The reproductive epidemiology focus at UNC is noteworthy for its attention to both maternal and paternal occupational exposures, the number of faculty and students involved, and their significant contribution to the literature.

While the occupational injury epidemiology program is younger and smaller--

reflecting the relatively recent growth of injury epidemiology as a subdiscipline--there are few other centers where this type of training is available. With extensive involvement of several faculty members, a substantial number of students, and the UNC Injury Prevention Research Center as a resource, the occupational injury program also makes a special contribution to the field.

A third special contribution of the UNC program is its concern with the social, economic, and political context of occupational health. This focus integrates UNC's traditional orientation toward social and cultural determinants of ill health with contemporary concerns about such issues as special populations at risk, economic globalization, and the changing workplace. The research of several faculty members bears on NORA concerns with the organization of work and special populations at risk, including Prof. Runyan's studies of child labor, Prof. Santana's research on the health of informally-employed workers, Dr. Lipscomb's work with African-American women in the poultry processing industry, and research by Prof. Loomis on social inequalities in occupational illness and injury risks. Prof. Wing's writings on philosophical aspects of epidemiology and his research on disparities in environmental exposures also address concerns about justice. Interest in these contextual issues is not a circumscribed area of research, however, but rather a perspective that informs the research and teaching of several of our faculty. As examples of the influence of this perspective, the Occupational Epidemiology course includes discussions of child labor and the health of female and minority workers, and student work has included a study of occupational injury in the US-Mexico border region as a unique area undergoing rapid economic and social change. Occupational Epidemiology faculty are shown on Table 10.

Table 8
Courses Required for the PhD in Epidemiology.

Course Number and Title		Credit Hours
Required for the PhD in Epidemiology		
EPID 168	Fundamentals of Epidemiology	4
EPID 201	Epidemiologic Research Methods	3
EPID 268	Theory and Quantitative Methods in Epidemiology	4
EPID 269	Advanced Methods for Epidemiologic Data Analysis	3
EPID 390	Epidemiology Doctoral Seminar	2
BIOS 110	Principles of Statistical Inference	3
BIOS 145	Principles of Experimental Analysis	3
Minimum of two substantive courses in separate areas of Epidemiology (e.g., occupational epidemiology, cancer epidemiology)		6 (minimum)
EPID 394	Dissertation	3 (minimum)
Additional Requirements for Occupational Epidemiology Trainees		
EPID 276	Occupational Epidemiology	3
PUBH 285	Interdisciplinary approaches in occupational health	3

Table 9.
Elective courses recommended for Occupational Epidemiology trainees.

Course Number and Title		Credit Hours
Epidemiology		
EPID 125	Principles of Injury Prevention and Control	3
EPID 213	Epidemiologic Surveillance in Public Health	3
EPID 219	Perinatal Epidemiology	3
EPID 223	Biochemical Epidemiology	3
EPID 233	Cancer Epidemiology and Pathogenesis	3
EPID 234	Cancer Epidemiology Methods	3
Environmental Sciences/Industrial Hygiene		
ENVR 141	Air and Industrial Hygiene	3
ENVR 144	Industrial Toxicology	3
ENVR 147	Occupational Safety and Ergonomics	3
ENVR 149	Health hazards of industrial operations	3
ENVR 159	Analytic Thought and Environmental Risk	3
ENVR 168	Comprehensive Radiation Biology	3
ENVR 191	Health Effects of Environmental Agents	3
ENVR 198	Biophysical Theory of Environmental Health	3
ENVR 242	Theory and Practice of Exposure Evaluation	3
ENVR 246	Advanced Methods of Exposure Assessment*	3
ENVR 291	Principles of Chemical Carcinogenesis	3
ENVR 292	Molecular Approaches to Environmental Toxicology	3
Biostatistics		
BIOS 160	Probability and Statistical Inference I	3
BIOS 161	Probability and Statistical Inference II	3
BIOS 164	Survey Sampling	3
BIOS 165	Analysis of Categorical Data	3

*Strongly recommended
Other relevant courses: The Labor Force (SOC 127); Occupations and Work (SOC 246)

Table 10
Occupational Epidemiology Faculty

Core faculty	Areas of Interest in Occupational Epidemiology
Dana Loomis (Professor & Program Director)	Injuries; musculoskeletal disorders, exposure assessment methods; international occupational health; special populations
Marilie Gammon (Associate Professor)	Breast cancer; esophageal cancer; gastric cancer
Andrew Olshan (Professor)	Parental occupation, pregnancy outcome and childhood cancer; exposure assessment methods
Stephen Marshall (Assistant Professor)	Injuries; quantitative methods
Charles Poole (Associate Professor)	Quantitative methods
David Savitz (Professor)	Pregnancy outcome; electromagnetic fields; pesticides & cancer
Jane Schroeder (Assistant Professor)	non-Hodgkin's lymphoma, renal cell cancer, uterine fibroids, pesticides and other agricultural exposures.
Steve Wing (Associate Professor)	Ionizing radiation, social justice and health; philosophy of epidemiology

Joint and Adjunct Faculty	Areas of Interest in Occupational Epidemiology
John Dement	Exposure assessment, construction
Hester Lipscomb	Musculoskeletal disorders; injuries; construction
Bonnie Rogers	Occupational health nursing, hazards to health workers, ethics
Kenneth Mundt	Surveillance, methods, injury and disability, historical exposure reconstruction, science policy
Carol Runyan	Injuries; violence; young workers; agriculture
Vilma Santana	Mental health; women; work organization
Timothy Wilcosky	Cancer; exposure assessment; quantitative methods

HEALTH SERVICES RESEARCH IN OCCUPATIONAL SAFETY AND HEALTH

This training program just began in July 2000 and intends to prepare researchers in Health Services Research in Occupational Safety and Health (HSROSH). The program is housed in the Department of Health Policy and Administration (HPAA) with linkages to the NCOSHERC, the Injury Prevention Research Center (IPRC), and the Cecil G. Sheps Center for Health Services Research (Sheps Center) so that students learning can be enhanced and fostered. Training facilities and linkages will be described in detail in that later section. The program receives strong institutional support in faculty salary support evidenced by substantial faculty support in HPAA and the Public Health Leadership Program where the NC OSHERC is housed. Faculty are shown in Table 11.

Training Plan

General Description

For this training program, the PhD in Health Policy and Administration (HPAA) is offered. The program provides the education for those who plan health services research careers in teaching and research. The goal of the program is to provide students the academic foundation, research experience, and professionalization within the health services research and occupational safety and health disciplines to become independent and creative investigators. The training program includes a minimum of 42 credit hours of graduate coursework beyond prerequisites, including the minor. Course credits must include: the departmental core; health services research; occupational safety and health; research methodology; and a minor area. Minor areas can be pursued within the Department of HPAA or through other university departments and may include such disciplines as sociology, political science, operations research, economics, financial management, epidemiology, demography, biostatistics, or others agreed upon by the student's advisor and the director of the doctoral program.

Each student is required to prepare a dissertation based on original research which tests, extends, or applies a set of concepts or principles from the selected disciplinary area to a problem in health services research in the field of occupational safety and health. Students present and orally defend a dissertation proposal and the dissertation itself. Students sit for a comprehensive examination in their last year of course work, normally during the summer of the second year. It is possible for a well prepared, directed and motivated student to complete the program in three years, but usually longer periods of time are required. However, all requirements for the degree must be completed within eight years from the date of first registration in the Graduate School.

Upon graduation, trainees will be qualified as HSROSH researchers who will work as scientists to explore the relationships between the structure and applications in and effectiveness of the delivery of occupational safety and health services, and how this impacts worker health and safety systems and health. Graduates will be highly desirable researchers in settings such as universities, state health departments, research institutes, industry, government, managed care systems, and worker insurance driven operations.

Table 11
Faculty for Health Services Research in Occupational Safety and Health

CORE FACULTY	
Edward Norton (Co-PI)	Healthcare economics, long term-care and aging, managed care and mental health, economics
Tom Ricketts	Rural healthcare, primary care, regionalization of services, political philosophy, policy implementation and development
Bonnie Rogers (PI)	Occupational health/safety, ethics in occupational health, hazards to health care workers
Carol Runyan	Injury prevention and control
SUPPORTING FACULTY	
William Dow	Health economics, international health, economic demography
Lorraine Johnson	Management, administration, program planning, and skin disease
Sally Stearns	Health economics, health policy, applied statistical methods
Bryan Weiner	Governance in health care, quality improvement implementation, community health partnerships
Susan Randolph	Occupational health and hazard surveillance
ADJUNCT FACULTY	
Richard Andrews	Environmental health policy, registration
David Coble	Safety in occupational health
Carol Epling	Occupational medicine education
Arnold Kaluzny	Assessment, program evaluation, development and operations of strategic alliances in health services
Kerry Kilpatrick	Operations research
Dana Loomis	Occupational epidemiology, health risks to vulnerable groups
Judith Ostendorf	Ergonomics in occupational health
Kay Campbell	Occupational health promotion, disability management

Curriculum of Study

The curriculum of study, beyond the prerequisites, requires approximately 42 credit hours of coursework (approximately 16 courses) excluding credits for the dissertation. Coursework required is inclusive of HPAA departmental core courses which focus on the science, logic, and utility of health services research; health services research methods occupational safety and health knowledge courses and electives related to the health services research in occupational safety and health; health services/applied research electives from which the students can select coursework in either the health services research or occupational safety and health field that complements the knowledge base needed; and the minor area of study.

1. Coursework

- 2 Doctoral Seminars in health policy, administration, and in organizational theory and health services, HPAA 300, HPAA 301 and HPAA 330;
- 2 courses in Statistical Analysis, HPAA 273 and HPAA 274, or BIOS 163 and 165, or ECON 273 and 274;
- 1 course in Advanced Methodology in Health Policy and Administration Research, HPAA 371;
- 1 seminar on Selected Topics in Health Policy and Administration, HPAA 305;
- 1 seminar in Teaching of Health Services Research, HPAA 304;
- 1 course in health services research methods, HPAA 272;
- 5 courses in occupational safety and health related topics including an integrative seminar.
- 5 courses in the minor area courses;
- 1 monthly research seminar, HPAA 360;
- elective courses in health services research, applied research, or occupational safety and health;
- Doctoral Dissertation, HPAA 394;

Curriculum guide/sequence of courses is shown in Tables 12 and 13.

2. Minor Area Requirements

The Department does not require that a minor be formally declared with the Graduate School, even though the student may elect to do so. At least one course of the minor must be in research or quantitative methods relevant to the minor field, and at least one course must be in theory relevant to the minor field.

If students elect to formally declare a minor in a particular discipline so that it will appear on their transcripts, then all graduate school requirements for doing so must be met. In general, the Graduate School requires that the minor consist of at least 15 credit hours, and that all courses counting towards the minor be listed (or cross-listed) in programs other than the student's major. In addition, the minor should be planned in advance, and both the major and minor programs must give the Graduate School written approval for the program.

Table 12
PhD Program Curriculum
Health Services Research in Occupational Safety and Health

HPAA Core Courses (17 credits)

Course	Title	Credits
*HPAA 300	Doctoral Seminar in Health Policy & Admin I	3
*HPAA 301	Doctoral Seminar in Health Policy & Admin II	3
*HPAA 304	Seminar in Teaching Health Policy & Admin	3
*HPAA 305	Selected Topics in Health Policy & Admin: Advanced Seminar	3
*HPAA 330	Doctoral Seminar in Organization Theory & Health Service Organization	3
*HPAA 360	Policy Seminar in Health Policy & Admin	2

HPAA Methods Courses (9 credits)

*HPAA 273	Linear Regression Models	3
*HPAA 274	Analysis of Categorical Data	3
*HPAA 371	Advanced Methodology in Health Policy & Admin	3

HPAA Health Services Research (3 credits)†

Select a course from list.

HPAA Minor Area of Study (15 credits)†

Specific courses are determined by minor area of study:
Epidemiology, Economics, Political Science, or Sociology

Occupational Safety & Health Requirements (13 credits)†

*PUBH 241	Seminar in Public Health/Occup. Health	2
*PUBH 285	Interdisciplinary Approaches to Occup. Health	2

Select 9 other credits of electives in Occupational Safety and Health from an approved list or approval from the Program Director.

HPAA Other

*HPAA 394	Doctoral Dissertation	6 (minimum)

* Required course

† While a student must complete 13 credits to fulfill the Occupational Safety and Health (OS&H) requirement, courses taken to fulfill the Health Services Research and Minor Area of Study requirements may also count toward the OS&H credits if they are relevant.

Table 13
Sample Program of Study: EPID Minor
Health Services Research in Occupational Safety and Health

HPAA Core Courses (17 credits)

Course	Title	Credits
*HPAA 300	Doctoral Seminar in Health Policy & Admin I	3
*HPAA 301	Doctoral Seminar in Health Policy & Admin II	3
*HPAA 304	Seminar in Teaching Health Policy & Admin	3
*HPAA 305	Selected Topics in Health Policy & Admin: Advanced Seminar	3
*HPAA 330	Doctoral Seminar in Organization Theory & Health Service Organization	3
*HPAA 360	Policy Seminar in Health Policy & Admin (spread out as 1 credit Fall/Spring semesters)	2

HPAA Methods Courses (9 credits)

*HPAA 273	Linear Regression Models	3
*HPAA 274	Analysis of Categorical Data	3
*HPAA 371	Advanced Methodology in Health Policy & Admin	3

HPAA Health Services Research (3 credits)†

HPAA 272	Methods for Health Policy Analysis and Technology Assessment	3

HPAA Minor Area of Study – Epidemiology (15 credits)†

*EPID 168	Fundamentals of Epidemiology	4
*EPID 268	Theory & Quantitative Methods in Epid.	5
EPID 125	Injury as a Public Health Problem	3
EPID 276	Occupational Epidemiology	3

Occupational Safety & Health Requirements (13 credits)†

*PUBH 241	Seminar in Public Health/Occup. Health	2
*PUBH 285	Interdisciplinary Approaches to Occup. Health	2

Select 9 other credits of electives in Occupational Safety and Health from an approved list or approval from the Program Director.

Examples listed below.

EPID 125	Injury as a Public Health Problem—3 credits (fulfills OS&H credits)
EPID 276	Occupational Epidemiology—3 credits (fulfills OS&H credits)
HPAA 272	Methods for Health Policy Analysis and Technology Assessment—3 credits (fulfills OS&H credits)

HPAA Other

*HPAA 394	Doctoral Dissertation	6 (minimum)
		TOTAL: 54 (minimum)

* Required course

† While a student must complete 13 credits to fulfill the Occupational Safety and Health (OS&H) requirement, courses taken to fulfill the Health Services Research and Minor Area of Study requirements may also count toward the OS&H credits if they are relevant.

CONTINUING EDUCATION AND OUTREACH

Needs Assessment

Needs assessments during this past grant period were conducted through the following sources:

1. Survey of students attending current continuing education programs.
2. Mailed questionnaire was sent to 5,000 people on the mailing list.
3. Information gathered at NC-OSHERC exhibit booth.
4. Information gathered by NIOSH/ERC booth at conferences
5. Information from the established Advisory Committee.
6. Information gathered through a needs assessment on the web site

Courses identified from the needs assessment process listed above include Fundamentals of Environmental Health, Environmental Regulations, Risk Assessment, Conducting Environmental Audits, Indoor Air Quality, Pulmonary Function Testing and Laboratory Safety. Many of these courses are being included in the Environmental Technician Certificate program. As a result of combined data from recent needs assessments, the Pulmonary Function Testing course will be offered for the first time at the Summer Institute, 2002.

EVALUATION

Course Evaluation

During previous years, evaluation of continuing education programs has been conducted as a student evaluation upon completion of the course. This evaluation process also includes:

i) evaluation by course director;
ii) post course tracking and evaluation by students;
iii) development of testing for courses;
iv) evaluation by advisory committee member attending courses
v) evaluation of course materials by UNC faculty members

Program Evaluation

An evaluation of the total continuing education activities is provided by the advisory board(s). These boards have been established for each of the 3 certificate programs as well as the total continuing education program. In formal meetings as well as informal conversations, these boards provide input related to current issues and future directions of the program. An example of this input is the recommendation of the overall advisory board to initiate the technician certificate programs in industrial hygiene, occupational safety and environmental.

Industrial Hygiene Technician Certificate Program

The Industrial Hygiene Technician certificate program continues to grow. As identified in an earlier needs assessment and recommended by the advisory board, there is a need throughout this region for training in the practical applications aspects of industrial hygiene. Enrollees in this program include students from academic programs, industry, consulting firms and government agencies. Since first offered in

1996, 486 students have enrolled, 289 have successfully completed and the remainder are actively taking either required or elective classes. We anticipate these numbers will continue to grow during the next grant period.

The program requires three weeks of training via continuing education courses. One week is required training and the remainder are electives selected from a listing of 12 courses that best fit the duties of the technician. Upon completion of each course, examinations are given. The program has become recognized by several regional groups and is now being offered in-house for their employees.

Safety Technician Certificate Program

The Safety Technician Certificate program was initiated at the Summer Institute series held in Williamsburg, VA in July 1999. The advisory board has outlined a curriculum that includes both required and elective courses. There are currently 180 students enrolled, 74 have successfully completed and the remainder are actively taking courses. The program is structured similar to the Industrial Hygiene certificate program.

Environmental Technician Certificate Program

The Environmental Technician Certificate program was initiated at the Winter Institute, 2002. There are currently 7 enrolled with the first expected to complete at the Summer Institute 2004.

Distance Education

The decision was made 2 years ago to incorporate distance-learning opportunities into the total continuing education program within NC-OSHERC. After careful review, a web based approach appeared to hold the greatest promise as a mechanism to deliver distance learning. A large advantage of this system is that students do not have to go to a specified location, but would have access anywhere a telephone connection to the Internet is available. Another major advantage over disc/cd systems is the ease in updating course materials.

The first course being developed in a web-based format is the Fundamentals of Industrial Hygiene. This 4 ½ day course is currently being offered in the traditional continuing education format at both the Summer and Winter Institutes. A source of funding within the School of Public Health – UNC was identified and the program is being implemented.

The second program is under development as well and will be available at the same time. It is the 4½ day Fundamentals of Occupational Safety course.

Both of these distance-learning courses will be available for both continuing education and academic credit. It is anticipated that other courses will be added to this method of delivery in the near future.

NORA

The goal of the NORA Research Support Program is to provide a focused effort to support NORA related research training, interdisciplinary research discussion and collaboration, when feasible, and dissemination and applications of research through continuing education.

Research training received by trainees is based on the curriculum of study in each department (e.g., epidemiology, occupational health nursing, industrial hygiene).

A doctoral seminar (PUBH 320) was developed by faculty using NORA as the framework for the course. Research related to the NORA priorities was presented by invited faculty from occupational medicine, industrial hygiene, epidemiology, safety/ergonomics, nursing, health education/evaluation, health services research, and toxicology. Trainees had the opportunity to learn about methods and approaches to study design and critique research presented. Students also critiqued relevant NORA related research in the current literature. Faculty assisted students with networking opportunities with agencies, seasoned researchers for ideas and collaborations, and with potential sources of funding.

Two conferences/symposium were held that offered opportunities to present/disseminate NORA related research. An international conference, primarily coordinated by UNC, was held in Baltimore in October, 2002: *Best Practices in Occupational Safety and Health Education, Training, and Communication: Ideas That Sizzle*. The Conference, attended by 300 + participants, was a huge success, and 120 abstracts were presented (more than 75% were NORA related). Dr. John Howard (NIOSH Director) gave the keynote address, which emphasized the importance of NORA. This conference was attended by five faculty and four NIOSH trainees from UNC.

The second NORA related conference was held at UNC in Chapel Hill in November 2002 as part of the 25th Anniversary celebration of the OSHERC. The conference opened with a keynote address presented by Dr. Kathleen Rest, Deputy Director of NIOSH, who discussed the history and current impact of NORA. The conference highlighted NORA related research (listed below in parentheses) conducted by three NIOSH trainees which included presentations on:

- Impact of ADA on Labor Force Participation of Persons with Disabilities (Special Populations)
- Cancer Mortality Among Nuclear Materials Production Workers (Cancer Research Methods)
- Dermal Exposure to Hexamethylene Diisocyanate During Point Spraying (Exposure Assessment Methods)

As part of the conference, Earl Dotter, an internationally recognized photojournalist, spoke at the conference and exhibited his photos on the hazards of work in America in the School of Public Health and at the Chapel Hill Museum for 2 months. This work also emphasized the importance of NORA through the need for continued research in these important areas. The photos exhibited were cross-linked with NORA priorities. The conference and exhibits were open to the public and attended by about 100 people.

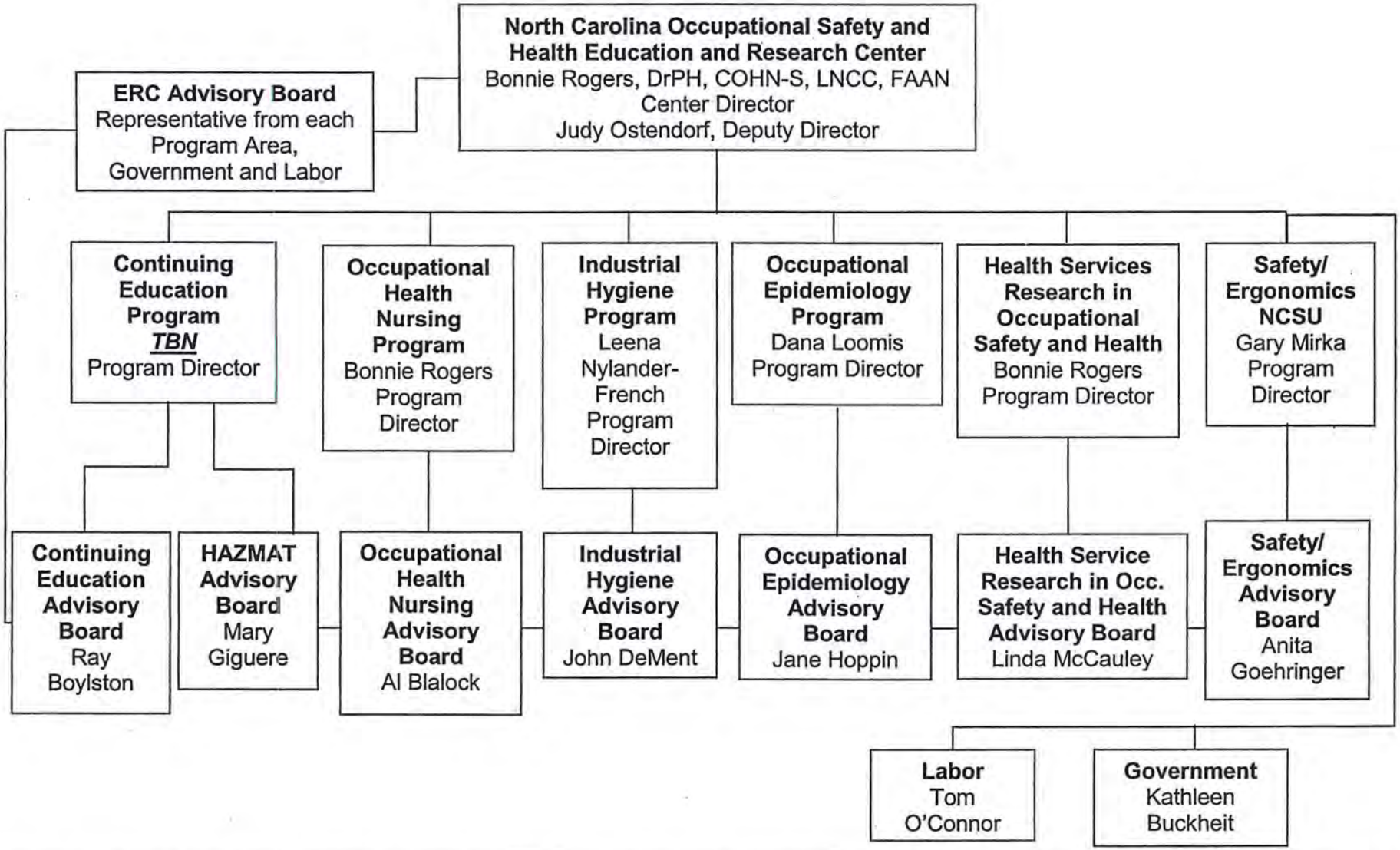
Interdisciplinary research interaction is accomplished in several ways: collaborative research projects among faculty and students where like interests exist which is already

being done; participation of students and faculty in the interdisciplinary seminar series and continuing education/outreach events which has a focus on NORA research; discussion at OSHERC Executive Committee (Program Directors) meetings to identify opportunities for students to engage in research projects; and participation of faculty and students in the doctoral seminar in occupational safety and health.

CONCLUSION

The NC OSHERC has prepared numerous master's and doctoral level graduates to the workforce prepared to deal with significant occupational health and safety issues and lead and advance the science and professions.

Technology advancement has fostered the opportunity to provide both academic and continuing distance education learning experiences which will further the opportunities for enrollment for students unable to relocate which to date has been witnessed. We continue to expand and enrich the learning lives of our students, and faculty to better improve the health and safety of our nation's working population.



The ERC Director is Bonnie Rogers. She oversees the OSHERC and the respective Program Directors oversee each program (CE, IH, OHN, EPI, HSROSH) within the ERC. The ERC Advisory Board works directly with the ERC Director. The CE, Hazmat, OHN, EPI, HSROSH and IH Advisory Boards work directly with the Program Director of each respective program area.

Publications that have resulted, in whole or in part, from training grant support

Industrial Hygiene

(*Indicates Industrial Hygiene Faculty.)

Altemose, B.; Flynn, M.R. and Sprankle J.: Application of a tracer gas challenge with a human subject to investigate factors affecting the performance of laboratory fume hoods. American Industrial Hygiene Association Journal 59:321-327, 1998.*

Archer, J.D.; Cooper, G.S.; Reist, P.C.; Storm, J.F. and Nylander-French, L.A.: Exposure to respirable crystalline silica in Eastern North Carolina farm workers. American Industrial Hygiene Association Journal (in press).*

Armendariz, A. and Leith, D.: Concentration measurement and counting efficiency for the aerodynamic particle sizer 3320. Journal of Aerosol Science 33:133-148, 2002.

Armendariz, A.J. and Leith, D.: A personal sampler for aircraft engine cold start particles: Laboratory development and testing. American Industrial Hygiene Association Journal (submitted 2002).

Armendariz, A.J.; Leith, D.; Boundy, M.; Goodman, R.; Smith, L. and Carlton, G.: Development and field demonstration of an electrostatic personal particle sampler. American Industrial Hygiene Association Journal (submitted 2002).*

Bhattacharyya, R. and Todd, L.A.: Spatial and temporal visualization of gases and vapors in air using computed tomography: numerical studies. Annals of Occupational Hygiene 41(1):105-122, 1997.

Boundy, M.; Leith, D.; Hands, D.; Gressel, M. and Burroughs, G.E.: Performance of industrial mist collectors over time. Applied Occupational and Environmental Hygiene 15 (12):928-935, 2000.*

Brown, J.S.; Kim, C.S.; Reist, P.C.; Zeman, K.I. and Bennett, W.D.: Generation of radiolabelled 'soot-like' ultrafine aerosols suitable for use in human inhalation studies. Aerosol Science and Technology, 2000.

Carlton, G. and Flynn, M.R.: A model to estimate worker exposure to spray paint mists. Applied Occupational and Environmental Hygiene 12(5):375:382, 1997.*

Carlton, G. and Flynn, M.R.: Field evaluation of an empirical-conceptual exposure model. Applied Occupational and Environmental Hygiene 12(8):555-561, 1997.*

Carlton, G. and Flynn, M.R.: The influence of spray painting parameters on breathing zone particle size distributions. Applied Occupational and Environmental Hygiene 12(11):744-750, 1997.*

Charles, L.E.; Loomis, D.; Shy, C.M.; Newman, B.; Millikan, R.; Nylander-French, L.A.; Couper, D.: Electromagnetic fields, polychlorinated biphenyls and prostate cancer mortality in electric utility workers. American Journal of Epidemiology (in press).

Choi, K; Serre, M.L. and Christakos, G.: Spatiotemporal BME mapping of health fields at different spatial scales. Journal of Exposure Analysis and Environmental Epidemiology (in press).

Cole, D.; Todd, L.A. and Wing, S.: Concentrated swine feeding operations and public health: a review of occupational and community health effects. Environ. Health Perspect. 108(8):685-699, 2000.

Cooper, S.J. and Leith, D.: Evaporation of metalworking fluid mist in laboratory and industrial collectors. American Industrial Hygiene Association Journal 59:45-51, 1998.

Egeghy, P.; Nylander-French, L.A.; Gwin, K.; Hertz-Picciotto, I. and Rappaport, S.M.: Self-Collected breath sampling for the biological monitoring of low-level benzene exposure among automobile mechanics. The Annals of Occupational Hygiene (in press).*

Egeghy, P.P.; Tornero-Velez, R. and Rappaport, S.M.: Environmental and Biological Monitoring of Benzene during Self-Service Automobile Refueling, Environ Health Perspect, 108:1195-1202, 2000.*

Farhat, S.K. and Todd, L.A.: Evaluation of open-path FTIR spectrometers for monitoring multiple chemicals in air. Applied Occupational and Environmental Hygiene 15(12):911-923, 2000.

Flynn, M.R. and Sills E.: On the use of computational fluid dynamics in the prediction and control of exposure to airborne contaminants – an illustration using spray painting. Annals of Occupational Hygiene 44(3):191-202, 2000.*

Flynn, M.R. and Sills, E.: Numerical simulation of human exposure to aerosols generated during compressed air spray-painting in cross-flow ventilated booths. Journal of Fluids Engineering 123(1):64-70, 2001.*

Flynn, M.R.; Gatano, B.; McKernan, J.; Dunn, K.; Balzicko, B. and Carlton G.N.: Modeling breathing-zone concentrations of airborne contaminants generated during compressed air spray painting. Annals of Occupational Hygiene 43(1):67-76, 1999.*

Fustinoni, S.; Colosio, C.; Colombi, A.; Lastrucci, L.; Yeowell-O'Connell, K. and Rappaport, S.M.: Albumin and Hemoglobin Adducts as Biomarkers of Exposure to Styrene in Fiberglass-Reinforced Plastics Workers, Int Arch Occup Environ Health 71:35-41, 1998.

George, D.K. and Flynn, M.R.: Industrial Hygiene Education, Training and Information Exchange. Patty's Industrial Hygiene, 5th Edition, Vol. 3. R.L. Harris ed. Chapter 51, pp. 2343-2374. John Wiley & Sons, New York, 2000.*

Jetter, J.; Guo, Z.; McBrian, J.; Flynn, MR. and Leith, D.: Charatcterization of emissions from burning incense. Science of the Total Environment (in press).*

Kolovos, A.; Christakos, G.; Serre, M.L. and Miller, C.T.: Computational BME-solution of stochastic advection reaction equation in the light of site-specific information. Water Resources Research (in press).

Leith, D. and Jones, D.L.: Cyclones. In: Handbook of Powder Science and Technology, 2nd ed., Fayed, M.E. and Otten, L. Eds., pp. 727-752, Chapman and Hall, New York, 1997.

Liljelind, I.E.; Rappaport, S.M.; Levin, J.O.; Stromback, A.E.; Sunesson, A.K. and Jarvholm, B.G.: Comparison of Self and Expert Assessment of Occupational Exposure to Chemicals, Scand J Work Environ Health, 27:311-317, 2001.

Lin, P.H.; Waidyanatha, S.; Pollack, G. and Rappaport, S.M.: Dosimetry of Chlorinated Quinone Metabolites of Pentachlorophenol in the Livers of Rats and Mice Based upon Measurement of Protein Adducts, Toxicol Appl Pharmacol 145:399-408, 1997.

Lin, P.H.; Waidyanatha, S.; Pollack, G.M.; Swenberg, J.A. and Rappaport, S.M.: Dose-specific Production of Chlorinated Quinone and Semiquinone Adducts in Rodent Livers Following Administration of Pentachlorophenol, Toxicol Sci, 47:126-133, 1999.

Lindstrom, A.; Yeowell-O'Connell, K.; Waidyanatha, S.; Golding, B.T.; Tornero-Velez, R. and Rappaport, S.M.: Measurement of Benzene Oxide in the Blood of Rats Following Administration of Benzene, Carcinogenesis 18:1637-1641, 1997.*

Lindstrom, A.B.; Yeowell-O'Connell, K.; Waidyanatha, S.; McDonald, T.A.; Golding, B.T. and Rappaport, S.M.: Formation of Hemoglobin and Albumin Adducts of Benzene Oxide in Mouse, Rat, and Human Blood, Chem Res Toxicol 11:302-310, 1998.

Lindstrom, A.B.; Yeowell-O'Connell, K.; Waidyanatha, S.; McDonald, T.A. and Rappaport, S.M.: Investigation of Benzene Oxide in Bone Marrow and Other Tissues of F344 Rats Following Metabolism of Benzene In Vitro and In Vivo, Chem Biol Interact, 122:41-58, 1999.

Mattorano, D.A. and Nylander-French, L.A.: Estimating dermal exposure to jet fuel (naphthalene) using an adhesive tape-stripping method. (submitted March 2002).

McCurdy, A.L.; Wijnberg, L.; Loomis, D.; Savitz, D.A.; Nylander-French, L.A.: Exposure to 60-Hz magnetic fields among working women and homemakers. The Annals of Occupational Hygiene 45(8): 643-650, 2001.*

Mihlan, G.J.; Todd, L.A. and Truong, K.N.: Assessment of occupational exposure patterns by frequency-domain analysis of time series data. Appl. Occup. Environ. Hyg. 15(1):120-30, 2000.

Nam, T.-G.; Sangaiah, R.; Gold, A.; Lacks, G.D.; Nylander-French, L.A. and French, J.E.: Synthesis of FMOC-protected *S*-arylcysteines and modified keratin sequence peptides as specific epitopes as immunogens. Polycyclic Aromatic Compounds (in press).

Parks, C.G.; Cooper, G.S.; Nylander-French, L.A.; Sanderson, W.S.; Dement, J.M.; Cohen, P.L.; Dooley, M.A.; Treadwell, E.L.; St. Clair, E.W.; Gilkeson, G.A.; Hoppin, J.A. and Savitz, D.A.: Occupational exposure to crystalline silica and risk of systemic lupus erythematosus (SLE): a population-based case-control study in the Southeastern United States. Arthritis and Rheumatism (in press).

Parks, C.G.; Cooper, G.S.; Nylander-French, L.A.; Storm, J.F., Archer, J.D.: Assessing exposure to crystalline silica from farm work: a population-based study in the Southeastern United States. (submitted December 2001).

Peters, T.; Boundy, M. and Leith, D.: Influence of upstream flow characteristics on filter efficiency. Filtration and Separation 38(10):40-47, 2001.*

Piper, A.; Todd, L. and Mottus, K.: A field study using open-path FTIR spectroscopy. Chemistry and Technology 3(2):69-79, 1999.

Rappaport S.M. and Yeowell-O'Connell, K.: Protein Adducts as Dosimeters of Human Exposure to Styrene, Styrene-7, 8-Oxide, and Benzene, Toxicol Let, 108:117-126, 1999.

Rappaport, S.M.; Weaver, M.; Taylor, D.; Kupper, L.L. and Susi, P.: Application of Mixed Models to Assess Aerosol Exposures Measured by Construction Workers during Hot Processes, Ann Occup Hyg, 43: 457-469, 1999.

Rappaport, S.M.; Yeowell-O'Connell, K.; Smith, M.T.; Dosemeci, M.; Hayes, R.B.; Zhang, L.; Li, G.; Yin, S. and Rothman, N.: Non-Linear Production of Benzene Oxide-Albumin Adducts with Human Exposure to Benzene, J Chromatog (B), in press.

Raynor, P.C. and Leith, D.: The influence of accumulated liquid on fibrous filter performance. Journal of Aerosol Science 31:19-34, 2000.

Raynor, P.C. and Leith,D.: Evaporation of accumulated multicomponent liquids from fibrous filters. Annals of Occupational Hygiene 43 (3):181-192, 1999.

Raynor, P.C.; Volckens, J. and Leith, D.: Modeling evaporative loss of oil mist collected by sampling filters. Applied Occupational and Environmental Hygiene 15 (1):90-96, 2000.*

Rosati, J.; Leith, D. and Raynor, P.C.: Determinants of filter lifetime. Filtration and Separation 36(10):30-32, 1999.*

Rosati, J.A.; Brown, J.S.; Peters, T.M.; Leith, D. and Kim, C.S.: A polydisperse aerosol inhalation system designed for human studies. Journal of Aerosol Science (in press).*

Ross, K. and Todd, L.A.: Field evaluation of a transportable open-path FTIR spectrometer for real-time air monitoring. Applied Occupational and Environmental Hygiene 17(2):131-143, 2002.

Samanta, A. and Todd, L.A.: Mapping chemicals in air using an environmental CAT scanning system: evaluation of algorithms. Atmos. Environ. 34(5):699-709, 2000.

Schultz, M.R.; Hertz-Picciotto, I.; Todd, L. and Ball, L.M.: Reconciling animal and human data in a cancer risk assessment of acrylonitrile. Scandinavian Journal of Work Environment and Health 27(1):14-20, 2001.

Surakka, J.; Fischer, T.; Rosén, G. and Nylander-French, L.A.: Assessment of ultraviolet radiation exposure in the wood surface coating industry. Applied Occupational and Environmental Hygiene 12(4): 261-270, 1997.

Symanski, E.; Kupper, L.; Hertz-Picciotto, I. and Rappaport, S.M.: A Comprehensive Evaluation of Long-Term Trends in Occupational Exposure. Part 2: Predictive Models for Declining Exposures, Occup Environ Med 55:310-316, 1998.*

Symanski, E.; Kupper, L.L. and Rappaport, S.M.: A Comprehensive Evaluation of Long-Term Trends in Occupational Exposure. Part 1: Description of the Database, Occup Environ Med 55:300-309, 1998.*

Tan, Y. and Flynn, M.R.: A field evaluation of the impact of transfer efficiency on worker exposure during spray painting. Annals of Occupational Hygiene 46(1):103-112, 2002.*

Tan, Y. and Flynn, M.R.: Experimental evaluation of a mathematical model for predicting transfer efficiency of a high volume – low pressure air spray gun. Applied Occupational and Environmental Hygiene 15(10):785-793, 2000.*

Tan, Y. and Flynn, M.R.: Methods for estimating the transfer efficiency of a compressed air spray gun. Applied Occupational and Environmental Hygiene 17(1):39-46, 2002.*

Taylor, D.J.; Kupper, L.L.; Rappaport, S.M. and Lyles, R.H.: A Mixture Model for Occupational Exposure Data with a Limit of Detection, Biometrics, 57:681-688, 2001.

Taylor, L.; Reist, P.C.; Boehlecke, B. and Jacobs, R.R.: Characterization of an aerosol chamber for human exposures to endotoxin. Applied Occupational and Environmental Hygiene 15(3):303-12, 2000.*

Thornburg, J and Leith, D.: Mist generation during metal machining. Journal of Tribology (ASME) 122:544-549, 2000.

Thornburg, J. and Leith, D.: Size distribution of mist generated during metal machining. Applied Occupational and Environmental Hygiene 15 (8):618-628, 2000.

Thornburg, J.; Cooper, S.J. and Leith, D.: Counting efficiency of the API aerosizer. Journal of Aerosol Science 4:479-488, 1999.

Todd, L.A. and Bhattacharyya, R.: Tomographic reconstruction of air pollutants: evaluation of measurement geometries. Applied Optics 36(30):7678-7688, 1997.

Todd, L.A.; Farhat, S.K.; Mottus, K.M. and Mihlan, G.J.: Experimental evaluation of an environmental CAT scanning system for mapping chemicals in air in real-time. Applied Occupational and Environmental Hygiene 16(1):45-55, 2001.

Todd, L.A.; Ramanathan, M.; Mottus, K.; Katz, R.; Dodson, A. and Mihlan, G.: Measuring chemical emissions using open-path fourier transform infrared (OP-FTIR) spectroscopy and computer-assisted tomography. Atmospheric Environment 35:1937-1947, 2001.

Tornero-Velez, R. and Rappaport, S.M.: Physiological Modeling of the Relative Contributions of Styrene-7,8-oxide Derived from Direct Inhalation and from Styrene Metabolism upon the Systemic Dose in Humans, Toxicol Sci, 64: 151-161, 2001.*

Tornero-Velez, R.; Symanski, E.; Yu, R.C.; Kromhout, H. and Rappaport, S.M.: Compliance versus Risk in Assessing Occupational Exposures to Chemicals, Risk Anal 17:279-292, 1997.*

Tornero-Velez, R.; Waidyanatha, S.; Echeverria, D. and Rappaport, S.M.: Measurement of Styrene-7,8-oxide and Other Oxidation Products of Styrene in Air, J Environ Meas, 2:111-117, 2000.*

Tornero-Velez, R.; Waidyanatha, S.; Licea-Pérez, H.; Osterman-Golkar, S.; Echeverria, D. and Rappaport, S.M.: Determination of Styrene and Styrene-7,8-oxide in Human Blood by Gas Chromatography-Mass Spectrometry, J Chromatog (B), 757:59-68, 2001.*

Troester, M.; Lindstrom, A.B.; Waidyanatha, S.; Kupper, L.L. and Rappaport, S.M.: Stability Of Hemoglobin and Albumin Adducts Of Benzene Oxide and 1,4-Benzoquinone After Administration Of Benzene To F344 Rats, Toxicol Sci, 54:88-94, 2000.

Troester, M.A.; Kupper, L.L. and Rappaport, S.M.: A Comparison of Nonlinear and Linear Models for Estimating Hemoglobin Adduct Stability, Biomarkers, 6:251-261, 2001.

Troester, M.A.; Lindstrom, A.B.; Waidyanatha, S.; Kupper, L.L. and Rappaport, S.M.: Stability of Hemoglobin and Albumin Adducts of Naphthalene Oxide, 1,2-Naphthoquinone, and 1,4-Naphthoquinone after Administration of Naphthalene to F344 Rats, Toxicol Sci, in press.

Tsai, C.H.; Lin, P.H.; Waidyanatha, S. and Rappaport, S.M. Metabolic Activation of Pentachlorophenol to Quinones and Semiquinones in Rodent Liver, Chem Biol Interact, 134:55-71, 2001.

van Wijngaarden, E.; Nylander-French, L.A; Millikan, R.C; Savitz, D.A. and Loomis, D.: Population-based case-control study of occupational exposure to electromagnetic fields and female breast cancer. Annals of Epidemiology 11(5):292-298, 2001.

van Wijngaarden, E.; Savitz, D.A.; Kleckner, R.C.; Mihlan, G.; Nylander-French, L.A.; Dufort, J.; Cai, J.; Loomis, D. and Kromhout, H.: Refinements in magnetic field exposure assignment for a case-cohort study of electrical utility workers. The Annals of Occupational Hygiene, 43(7): 485-492, 1999.

Volckens, J. and Leith, D.: An electrostatic sampler for semi-volatile aerosols I. Chemical artifacts. Environmental Science and Technology (submitted 2002).*

Volckens, J. and Leith, D.: An electrostatic sampler for semi-volatile aerosols II. Physical artifacts. Environmental Science and Technology (submitted 2002).*

Volckens, J.; Boundy, M. and Leith, D.: Mist concentration measurements II: laboratory and field evaluations. Applied Occupational and Environmental Hygiene 15 (4):370-379, 2000.*

Volckens, J.; Boundy, M.; Leith, D. and Hands, D.: Oil mist concentration: a comparison of sampling methods. American Industrial Hygiene Association Journal 60: 684-689, 1999.*

Wagner, J and Leith, D.: Passive aerosol sampler and methods. US Patent 6,321,608, granted 27 November 2001.*

Wagner, J. and Leith, D.: Field tests of a passive aerosol sampler. Journal of Aerosol Science 32:33-48. 2001.

Wagner, J. and Leith, D.: Passive aerosol sampler. I: Principle of Operation. Aerosol Science and Technology 34(2):186-192, 2001.*

Wagner, J. and Leith, D.: Passive aerosol sampler. II: Wind tunnel experiments. Aerosol Science and Technology 34(2):193-201, 2001.*

Waidyanatha, S.; Troester, M.A.; Lindstrom, A.B. and Rappaport, S.M.: Measurement of Hemoglobin and Albumin Adducts of Naphthalene-1,2-oxide, 1,2-Naphthoquinone and 1,4-Naphthoquinone after Administration of Naphthalene to F344 Rats, Chem Biol Interact (in press).

Waidyanatha, S.; Yeowell-O'Connell, K. and Rappaport, S.M.: A New Assay for Albumin and Hemoglobin Adducts of 1,2- and 1,4-Benzoquinones, Chem Biol Interact 115:117-139, 1998.

Weaver, M.A.; Kupper, L.L.; Taylor, D.; Kromhout, H.; Susi, P. and Rappaport, S.M.: Simultaneously Assessing Occupational Exposures from Multiple Worker Groups, Ann Occup Hyg, 45:525-542, 2001.

Yeowell-O'Connell, K.; Pauwels, W.; Severi, M.; Jin, Z.; Walker, M. R.; Rappaport, S.M. and Veulemans, H.: Comparison of Styrene-7,8-oxide Adducts Formed Via Reaction with Cysteine, N-terminal Valine, and Carboxylic Acid Residues in Human, Mouse, and Rat Hemoglobin, Chem Biol Interact 106:67-85, 1997.

Yeowell-O'Connell, K.; Rothman, N.; Smith, M.T.; Hayes, R.B.; Li, G.; Waidyanatha, S.; Dosemeci, M.; Zhang-Yin, S.; Titenko-Holland, N. and Rappaport, S.M.: Hemoglobin and Albumin Adducts of Benzene Oxide Among Workers Exposed to High Levels of Benzene, Carcinogenesis 19:1565-1571, 1998.

Yeowell-O'Connel, K.; Rothman, N.; Waidyanatha, S.; Smith, M.T.; Hayes, R.B.; Li, G.; Bechtold, W.E.; Dosemeci, M.; Zhang, L.; Yin, S. and Rappaport, S.M.: Albumin Adducts of 1,4-Benzoquinone and Benzene Oxide among Smokers and Non-smokers Exposed to Benzene in China, CancerEpid Biom Prev, 10: 831-838, 2001.

Yu, R.C. and Rappaport, S.M.: A Lung Retention Model based upon Michaelis-Menten-Like Kinetics, Environ Health Perspect 105:496-503, 1997.

Occupational Health Nursing

Ostendorf, J. Contributing author to chapter, "Health promotion and health education" in AAOHN's Core Curriculum for Occupational Health Nursing, Orlando, FL, W.B. Saunders, 1997.

Ostendorf, J. &Buckheit, K (1999). A Common Sense Approach To Reducing Work Related Musculoskeletal Disorders: A Special Report. Business and Legal Reports, Inc.: CT.

Ostendorf, J., Rogers, B., Bertesche, P. (2000). Ergonomics: CTD management evaluation tool. AAOHN Journal: 48:1, pp. 17-24.

Rogers, B. & Ostendorf, J. (2000). Occupational health nursing. Chapter 53 in Patty's Industrial Hygiene. (5th ed., Vol 4). Robert Harris (Ed). John Wiley & Sons.

Randolph, SA. & Silberstein, C. (1982). Planning for the hypertensive employee in industry. *Occupational Health Nursing*, 30(7),19-23.

Randolph, SA. (1984). Stress, working women and an occupational stress model. *Occupational Health Nursing*, 32(12), 622-625.

Randolph, SA. (1987). Contact lens survey: Implications for the occupational health nurse. *AAOHN Journal*, 35(1), 6-12.

Randolph, SA. & Zavon, MR. (1987). Guidelines for contact lens use in industry. *Journal of Occupational Medicine*, 29(3), 237-242.

Randolph, SA. & Dalton, PC. (1989). Limited duty work: An innovative approach to early return to work. *AAOHN Journal*, 37(11), 446-453.

Randolph, SA. (1992). Editorial: Ergonomic strategies in the workplace. *AAOHN Journal*, 40(3), 103.

Randolph, SA. & Migliozzi, NA. (1993). The role of the agricultural health nurse: Bringing together community and occupational health. *AAOHN Journal*, 41(9), 429-433.

Migliozzi, NA. & Randolph, SA. (1993). Editorial: Agricultural safety and health. *AAOHN Journal*, 41(9), 413.

Frazier, LM., Jones, B., Darcey, D., Langley, R., & Randolph, SA. (1994). Mandatory reporting of occupational health problems: A new surveillance program in North Carolina. *North Carolina Medical Journal*, 55(11), 2-7.

Randolph, SA. (1995). AAOHN Advisory: Over the counter medications. *AAOHN Journal*, 43(1), 8A; Revised January 2001.

Randolph, SA. (1996). Medication management in the workplace. *AAOHN Journal*, 44(10), 508-514.

Jones, B. & Randolph, SA. (1997). Reporting of occupational illnesses and injuries in North Carolina. *North Carolina Medical Journal*, 58(5), 2-5.

Randolph, SA. (2001). AAOHN Advisory: Job security for the 21st century. *AAOHN Journal*, 49(4).

Randolph, SA. (in press). Roles of the occupational health nurse. In B Rogers, Occupational Health Nursing: Concepts and Practice (2nd Ed.). Philadelphia, PA: WB Saunders.

Rogers, B., Randolph, SA., & Mastroianni, K. (in press). Occupational Health Nursing Guidelines for Primary Clinical Conditions (3rd Ed.). Beverly, MA: OEM Health Information, Inc.

Rogers, B. Confidentiality and genetic information. AAOHN Journal, 49:321-322, 2001.

Rogers, B. Ethical principles and occupational health. AAOHN Journal, 48:456-457, 2000.

Rogers, B. Why a code of ethics? AAOHN Journal, 49:11-12, 2001.

Rogers, B. Occupational health hazards to municipal health care workers. State of the Art Reviews in Occupational Medicine, 15, 2001.

Rogers, B. Ethical principles in occupational health. AAOHN Journal, 48: 456-457, 2000.

Rogers, B. Ethical issues in occupational health. American Journal of Public Health, submitted.

Rogers, B., Frazier, L. Worksite assessment. American Journal of Family Practice, submitted.

Rogers, B. and Livesey, K. Occupational health nursing practice in health surveillance, screening, and prevention activities. AAOHN Journal, In press, 1999-2000.

Rogers, B., Agnew, J., and Pompeii, L. Occupational health nursing research priorities. AAOHN Journal,

48: 9-16, 2000.

Rogers, B., Pompeii, L., and Short, S. Migraine headache and practice in the occupational health setting. AAOHN Journal, In press, 1999-2000.

Rogers, B. , Goodno, L. Evaluation of interventions to reduce needlestick injuries in health care occupations.

American Journal of Preventive Medicine, 18, 90-98, 2000.

Ostendorf, J., Rogers, B., and Bertsche, P. Development of an ergonomic tool for evaluation. AAOHN Journal:

48: 17-24, 2000.

Rogers, B. Occupational health nursing expertise. Journal UOEH, 20: 1998.

Rogers, B. Occupational health nursing expertise. AAOHN Journal, 46: 43, 497-503, 1998.

Rogers, B. Descriptive statistics. AAOHN Journal, 46: 266-67, 1998.

Rogers, B. and Cox, A. Expanding horizons: Integrating environmental health into occupational health nursing. AAOHN Journal, 46: 9-13, 1998.

Rogers, B. Epidemiology: An investigative approach in occupational health. AAOHN Journal, 46: 43, 1998.

Chamberlin, E. and Rogers, B. Competencies in occupational health nursing: A national study. AAOHN Journal, 45 (9): 431-437, 1997.

Rogers, B. AAOHN Advisory: Developing clinical guidelines or protocols for practice. AAOHN Journal, 45: 476A, 1997.

Rogers, B. Beginning in research. AAOHN Journal, 45: 513-514, 1997.

Rogers, B. Research and the internet. AAOHN Journal, 45: 204-205, 1997.

Blix, A. and Rogers, B. Writing abstracts. AAOHN Journal, 45: 513-514, 1997.

Rogers, B. Health hazards in nursing and health care: An overview. American Journal of Infection Control, 25: 248-261, 1997.

Safe Work in the 21st Century, Report of the Institute of Medicine Committee, 2000.

Enfermagen Do Trabalho: Conceitos e Practica. Lusociencia, Loures, Portugal, 1997. W.B. Saunders, Copyright, 1994.

Occupational Health Nursing Guidelines for Primary Clinical Conditions, Third Edition, OEM Press, In Press, 2002.

Occupational Health Nursing: Concepts and Practice. W.B. Saunders, 2nd Edition, In Press, 2002.

Nursing, Health, & Environment, Report of the Institute of Medicine Committee, 1995.

BOOK CHAPTERS

Occupational Health Nurse: Roles and Requirements, Current and Future Trends. Chapter in Swanson & Niles, Community Health Nursing, W.B. Saunders, 2001

Occupational Health Nursing. Chapter in James, S. Nursing in the Community, Jones & Bartlett, 2001.

Ethical Issues in Occupational Health. Chapter in D. Dyck, Disability management: theory, strategy, and industry practice, 2000.

Occupational Health Nursing. Chapter in Robert Harris, Ed., Patty's Industrial Hygiene, John Wiley & Sons, 2000.

Health and Safety in Nursing Practice. Chapter in Lindeman, C. & McAthie, M.L., Nursing Fundamentals, Lippincott, 2001.

Community Health Nursing in Occupational Health. Chapter in Stanhope & Lancaster, Community Health Nursing, Mosby, In Press, 1999.

International Occupational Health Nursing. Chapter in Bunn, W., International Occupational and Environmental Medicine. Mosby, In Press, 1998.

Research in Occupational Health Nursing. Chapter in AAOHN Core Curriculum in Occupational Health Nursing. W.B. Saunders, 1997.

Occupational Health Nursing Practice. Chapter in AAOHN Core Curriculum in Occupational Health Nursing. W.B. Saunders, 1997.

Occupational Epidemiology

(**Bold** indicates Occupational Epidemiology Faculty.)

Lipscomb HJ & **Dement** JM. Respiratory Diseases Among Union Carpenters: Cohort and Case-Control Analyses. Am J Indus Med 33:131-150, 1998.

Dement JM, Hensley L, Kieding S & Lipscomb HJ. Proportionate Mortality Among Union Members Employed at Three Texas Refineries. Am J Indus Med 33:327-340, 1998.

Dement JM & Lipscomb HJ. Workers' Compensation of North Carolina Residential Construction Workers: 1986-1994. App Occup Envir Hyg 14:97-106, 1999.

Wang E, **Dement** JM & Lipscomb HJ. Mortality among North Carolina Construction Workers: 1988-1994. App Occup Envir Hyg 14:45-58, 1999.

Lipscomb HJ, **Dement** JM, McDougall V, Kalat J. Work-related eye injuries among union carpenters. Appl Occup Environ Hyg 14:665-676, 1999.

Lipscomb HJ, **Dement** JM, Rodriguez-Acosta R. Deaths from External Causes of Injury Among construction Workers in North Carolina, 1988-1994. Appl Occup Environ Hyg 15(7):569-580, 2000.

Lipscomb HJ, **Dement** JM, Gaal J. Cameron W., McDougall V. Work-related injuries in drywall installation. Appl Occup Environ Hyg 15(10):794-802, 2000.

Dement JM. Wood Dust. Chapter In: Bingham E, Cohrssen B, Powell C (Eds), Patty's Toxicology, Fifth Edition, Volume I, John Wiley & Sons, Inc., New York, NY, 2000.````

Lipscomb HJ, **Dement** JM. Respiratory diseases among union carpenters: cohort and case-control analyses. American Journal of Industrial Medicine 33:131-150, 1998.

Dement JM, Hensley L, Kieding S, Lipscomb HJ. Proportionate mortality among union members employed at three Texas refineries. American Journal of Industrial Medicine 33:327-340, 1998.

Morbidity and Mortality Weekly Report (MMWR). Centers for Disease Control and prevention. Community exposure to toluene diisocyanate from a polyurethane manufacturing plant - North Carolina, 1997. Reported by: Darcey D, Lipscomb H, Cherry L, Cooper M, Pate W, Smith CG, and Division of Health Assessment , Agency for Toxic Substances and Disease Registry; June 1998.

Dement JM, Lipscomb HJ. Workers' compensation experience of North Carolina residential construction workers, 1986-1994. Applied Occupational and Environmental Hygiene 14: 97-106, 1999.

Wang E, **Dement** JM, Lipscomb HJ. Mortality of construction workers N.C. 1988-1994. Applied Occupational and Environmental Hygiene 14: 45-48, 1999.

Lipscomb HJ, Dement JM, McDougall V, Kalat J. Work-related eye injuries in union carpenters. Applied Occupational and Environmental Hygiene 14:665-676, 1999.

Lipscomb HJ. Effectiveness of interventions to prevent work-related eye injuries. American Journal of Preventive Medicine18(4S):27-32, 2000.

Lipscomb HJ, Dement JM, Rodriquez-Acosta. Deaths from external causes of injury among construction workers in N.C. 1989-1994. Applied Occupational and Environmental Hygiene 15(7):569-580,2000.

Lipscomb HJ, Dement JM, Gaal J, Cameron W, McDougall V. Injuries and costs associated with drywall installation. Applied Occupational and Environmental Hygiene_15(10):794-802, 2000.

Lipscomb HJ, Li Leiming. Injuries among teens employed in the homebuilding industry in N.C. Injury Prevention 7:205-209, 2001.

Darcey D, **Lipscomb** HJ, Epling C, Pate W, Cherry L, Bernstein J. Clinical findings of residents near a polyurethane foam manufacturing plant. Archives of Environmental Health. (*In press*)

Lipscomb HJ, Moon SD, Li L, Pompeii L, Kennedy MQ. Evaluation of the North Country on the Job Network: a model of facilitated care for injured workers in rural upstate New York. Journal of Occupational and Environmental Medicine 246-257, March 2002.

Borja-Aburto VH, Castillejos M, Gold DR, Bierzwinski S, Loomis D. Mortality and ambient fine particles in Southwest Mexico City, 1993-1995. Environ Health Perspec 1998;106:849-855.

Loomis D, Kromhout H, Kleckner RC, Savitz DA. Effects of analystical treatment of exposure data on associations of cancer and occupational magnetic field exposure. Am J Ind Med 1998;34:49-56.

Loomis DP, Richardson DB. Race and the risk of fatal occupational injury. Am J Public Health 1998;88:40-44.

McQuiston TH, Zakocs R, **Loomis** D. The case for stronger OSHA enforcement: evidence from evaluation research. Am J Public Health 1998;88:1022-1024.

Pereira LAA, **Loomis** D, Conceicã GMS, Braga LFA, Arcas RM, Kishi HS, Singer JM, Böhm GM, Saldiva PHN. Association between air pollution and intrauterine mortality in São Paula, Brazil. Environ Health Perspec 1998;106:325-329.

Savitz DA, Checkoway H, **Loomis** D. Magnetic field exposure and neurodegenerative disease mortality among electric utility workers. Epidemiology 1998;9:398-404.

Savitz DA, **Loomis** D, Tse CKJ. Electrical occupations and neurodegenerative disease: analysis of US mortality data. Arch Environ Health 1998;53:71-74.

Silva M, Santana VS, **Loomis** DP. Mortalidade proporcional entre militares da Marinha do Brasil, 1991-1995 – resultados prelimnares. Arquivos de Medicina Naval 1998;59(2):7-16.

Kromhout H, **Loomis** D. Uncertainty in the relation between exposure to magnetic fields and brain cancer due to assessment and assignment of exposure and analytical methods in dose-response modeling. Ann New York Acad Sci 1999;895:141-155.

Loomis D, Castillejos M, Gold DM, McDonnell W, Borja-Aburto VH. Air pollution and infant mortality in Mexico City. Epidemiology 1999;10:118-123.

Loomis D, DuFort V, Kleckner RC, Savitz DA. Fatal occupational injuries among electric power company workers. Am J Ind Med 1999;35:302-309.

Loomis D, Lagorio S, Salvan A, Comba P. Update of evidence on the association of childhood leukemia and 50/60 Hz magnetic field exposure. J Expo Anal Enviorn Epidemiol 1999;2:99-105.

Loomis D, Salvan A, Kromhout H, Kriebel D. Selecting indices of occupational exposure for epidemiologic studies. Occupational Hygiene 1999;5:73-91.

Petropoulos EA, Felknor S, Ivanov I, **Loomis** D. Is short-term training useful in international environmental and occupational health projects? Experience from the Balkans and Latin America. Int J Occup Environ Health 1999;5:223-233.

Santana VS, **Loomis** D, Wing S. Bahia-Carolina program in environmental justice. Int J Occup Environ Health 1999;5:218-222.

Santana VS, Silva M, **Loomis** D. Brain neoplasms among naval military men. Int J Occup Environ Health 1999;5:88-94.

Santana VS, Silva M, **Loomis** D. Por que as neoplasias de cérebro são comuns em militares da marinha? Arq Bras Med Naval 1999;60:22-31.

Van Wijngaarden E, Savitz D, Kleckner RC, Mihlan G, Nylander-French LA, Dufort V, Cai JW, **Loomis** D, Kromhout H. Refinements inmagnetic field exposure assignment for a case-cohort study of electrical utility workers. Annals of Occupational Hygiene 1999;43:485-492.

Castillejos M, Borja-Aburto VH, Dockery DW, Gold DR, **Loomis** D. Airborne coarse particles and mortality. Inhalation Toxicology 2000;12(suppl):61-72.

Loomis D, Schulz M. Mortality from six work-related cancers among African-Americans and Latinos. Am J Ind Med 2000;38:565-575.

Moracco KE, Runyan CW, **Loomis** D, Wolf SH, Napp D, Butts JD. Killed on the clock: a statewide study of occupational homicide, 1977-91. Am J Ind Med 2000 37:629-636.

Savitz D, Cai J, van Wijngaarden E, **Loomis** D, Mihlan G, Dufort V, Kleckner RC, Nylander French L, Kromhout H, Zhou H. *Case-cohort analysis of brain cancer and leukemia in electric utility workers using a refined job-exposure matrix. American Journal of Industrial Medicine 2000;38:417-25.*

Schulz M, **Loomis** D. Occupational Bladder Cancer Mortality among Racial and Ethnic Minorities in 21 States. Am J Ind Med 2000 38:90-98.

Van Wijingaarden E, Savitz DA, Kleckner RC, Cai J, **Loomis** D. Exposure to electromagnetic fields and suicide among electric utility workers: a nested case-control study. J Occup Environ Med 2000;57:258-263.

Loomis D, Wolf S, Runyan DW, Marshall SW, Berry JD. *Homicide on the job: workplace and community determinants. Am J Epidemiol 2001;154:410-417.*

McCurdy AL, Wijnberg L, **Loomis** D, Savitz DA, Nylander-French LA. Exposure to 60-Hz magnetic fields among working women and homemakers. Ann Occup Hyg 2001;45:643-650.

Santana VS, **Loomis** D, Newman B. Housework, paid work and psychiatric symptoms. Rev Saúde Pública 2001;35:16-22.