



PB98-130685

The Johns Hopkins University  
School of Hygiene and Public Health  
Department of Environmental Health Sciences  
615 N. Wolfe street  
Baltimore, Maryland 21205

**FINAL PERFORMANCE REPORT**

Occupational Health Educational Resource Center

July 1, 1992 - June 30, 1997

September 29, 1997

Morton Corn, Ph.D., C.S.P.  
Director

Jacqueline Agnew, R.N., Ph.D.  
Deputy Director

Grant T42/CCT310419-03

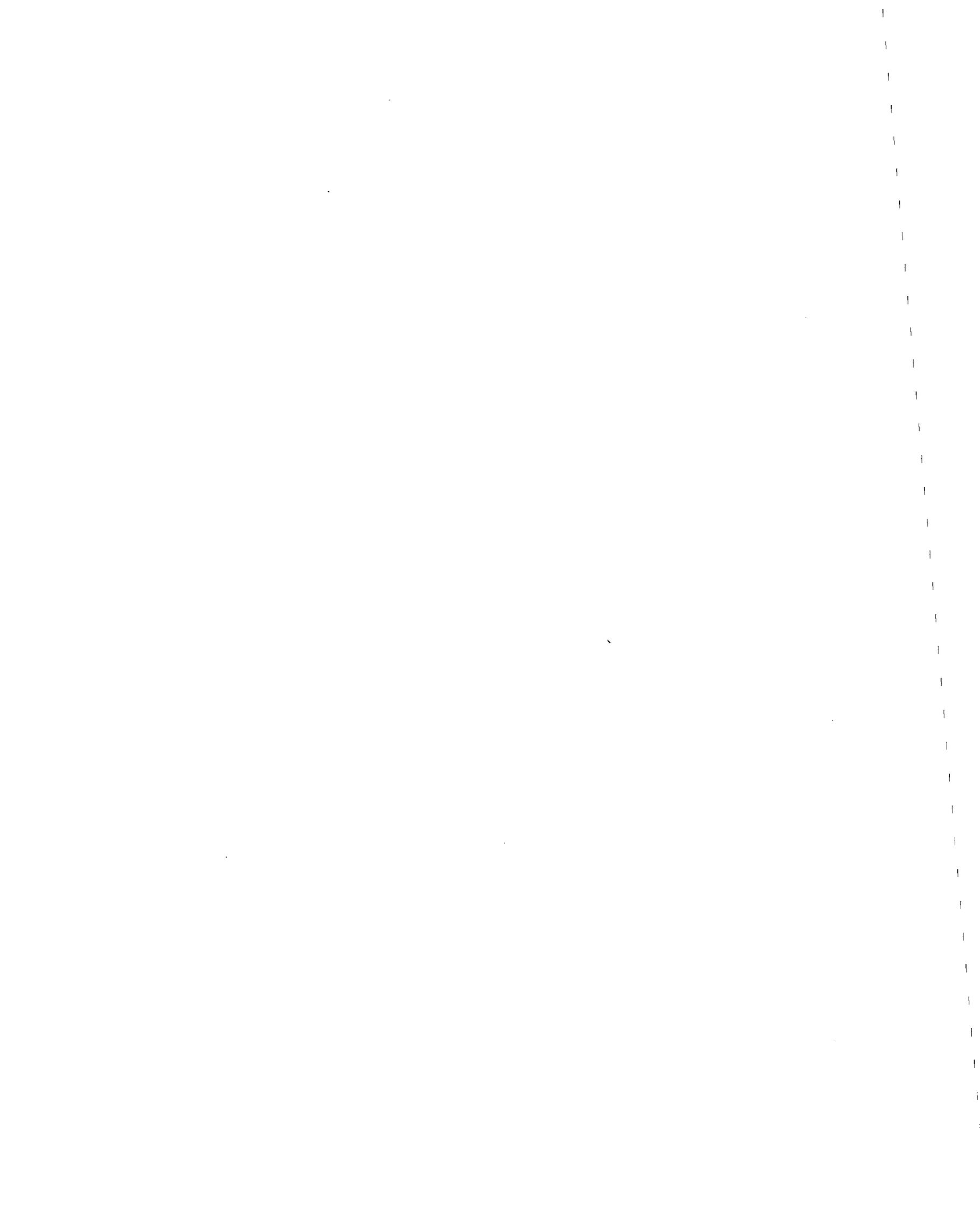
REPRODUCED BY: **NTIS**  
U.S. Department of Commerce  
National Technical Information Service  
Springfield, Virginia 22161





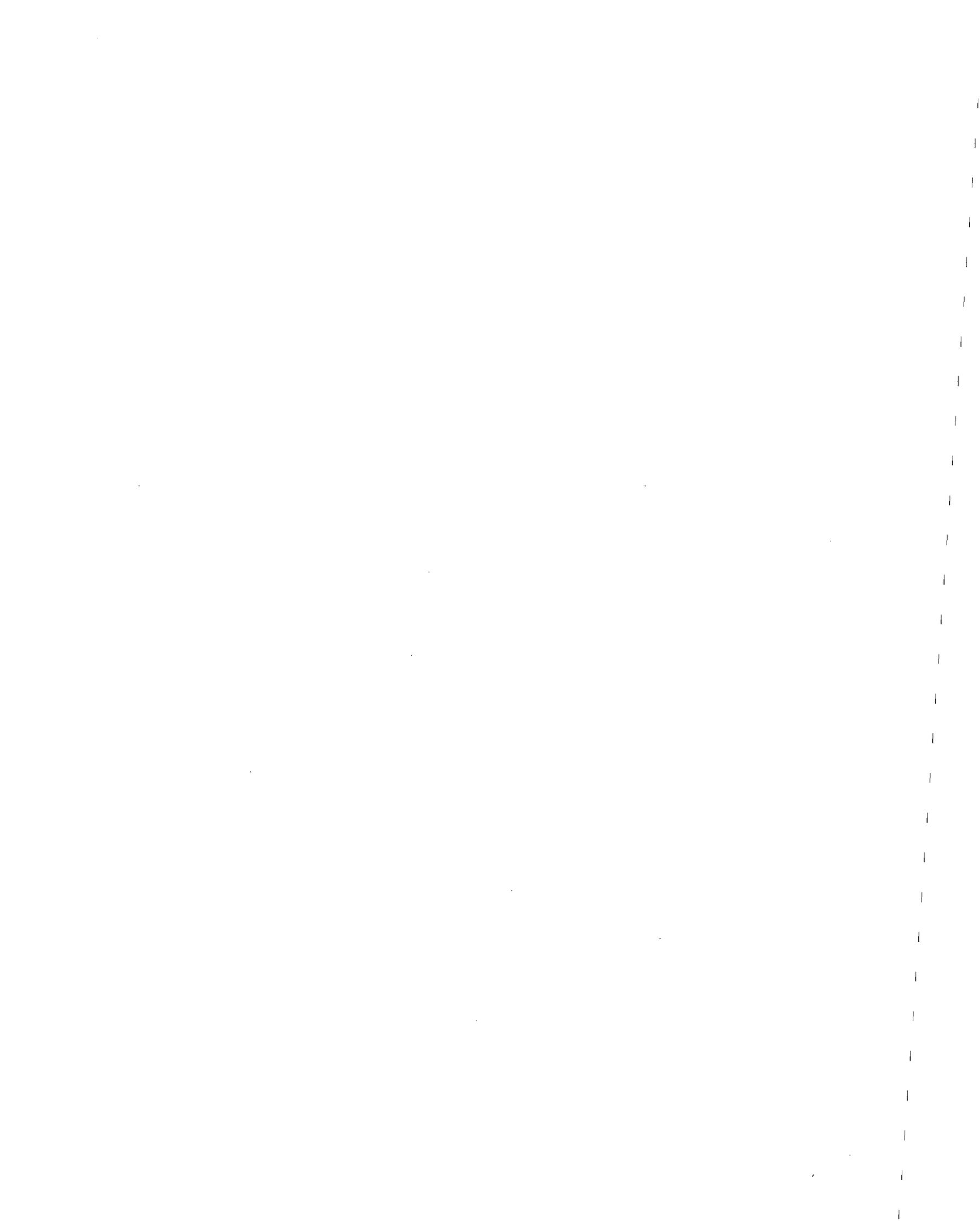
PB98-130685

<b>REPORT DOCUMENTATION PAGE</b>		1. REPORT NO.	2.	3.
4. Title and Subtitle Occupational Health Educational Resource Center, Johns Hopkins University, Final Performance Report, September 29, 1997				5. Report Date 1997/09/29
7. Author(s) Corn, M., and J. Agnew				6.
9. Performing Organization Name and Address				8. Performing Organization Rept. No.
				10. Project/Task/Work Unit No.
				11. Contract (C) or Grant(G) No. (C) (G) T42-CCT-310419
12. Sponsoring Organization Name and Address Department of Environmental Health Sciences, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Maryland				13. Type of Report & Period Covered
				14.
15. Supplementary Notes				
16. Abstract (Limit: 200 words) This report briefly traced the development of the Occupational Health Educational Resource Center (ERC) at Johns Hopkins University from its beginnings in 1977 to the current time. NIOSH funds were responsible for the development of the present interdisciplinary educational program. An emphasis of the report was the contribution students who have participated in the programs made to the field of occupational health once they graduated. The industrial hygiene program has been accredited by the Accreditation Board for Engineering and Technology since 1990. Opportunities were being developed for joint degree programs with the Department of Geography and Environmental Engineering. The occupational health nursing program had a new masters degree option. In the area of occupational medicine, courses have been revised with the development of three course core curriculum with increased interdisciplinary emphasis. The area of occupational injury prevention and safety sciences added courses to expand its curriculum and developed multiple field experience sites for research training along with large databases capable of supporting occupational injury research. Continuing education and outreach has been expanded with several continuing education offerings being provided during the departmental Summer Institute.				
17. Document Analysis a. Descriptors				
b. Identifiers/Open-Ended Terms				
End-Date-06-30-1997, NIOSH-Publication, NIOSH-Grant, Grant-Number-T42-CCT-310419, Occupational-health-nursing, Training, Education, Educational-resource-centers, Industrial-hygiene, Occupational-health-programs				
c. COSATI Field/Group				
18. Availability Statement		19. Security Class (This Report)		21. No. of Pages 70
		22. Security Class (This Page)		22. Price



## TABLE OF CONTENTS

	Page
I. Abstract	1
I. Significant Findings	2
II. Program Areas and Major Contributions	3
A. Background of Center	3
B. Industrial Hygiene	9
C. Occupational Health Nursing	18
D. Occupational Medicine	28
E. Occupational Injury Prevention / Safety Sciences	39
F. Continuing Professional Education and Outreach	51
G. Conclusions	60
III. Publications Resulting from Grant	61

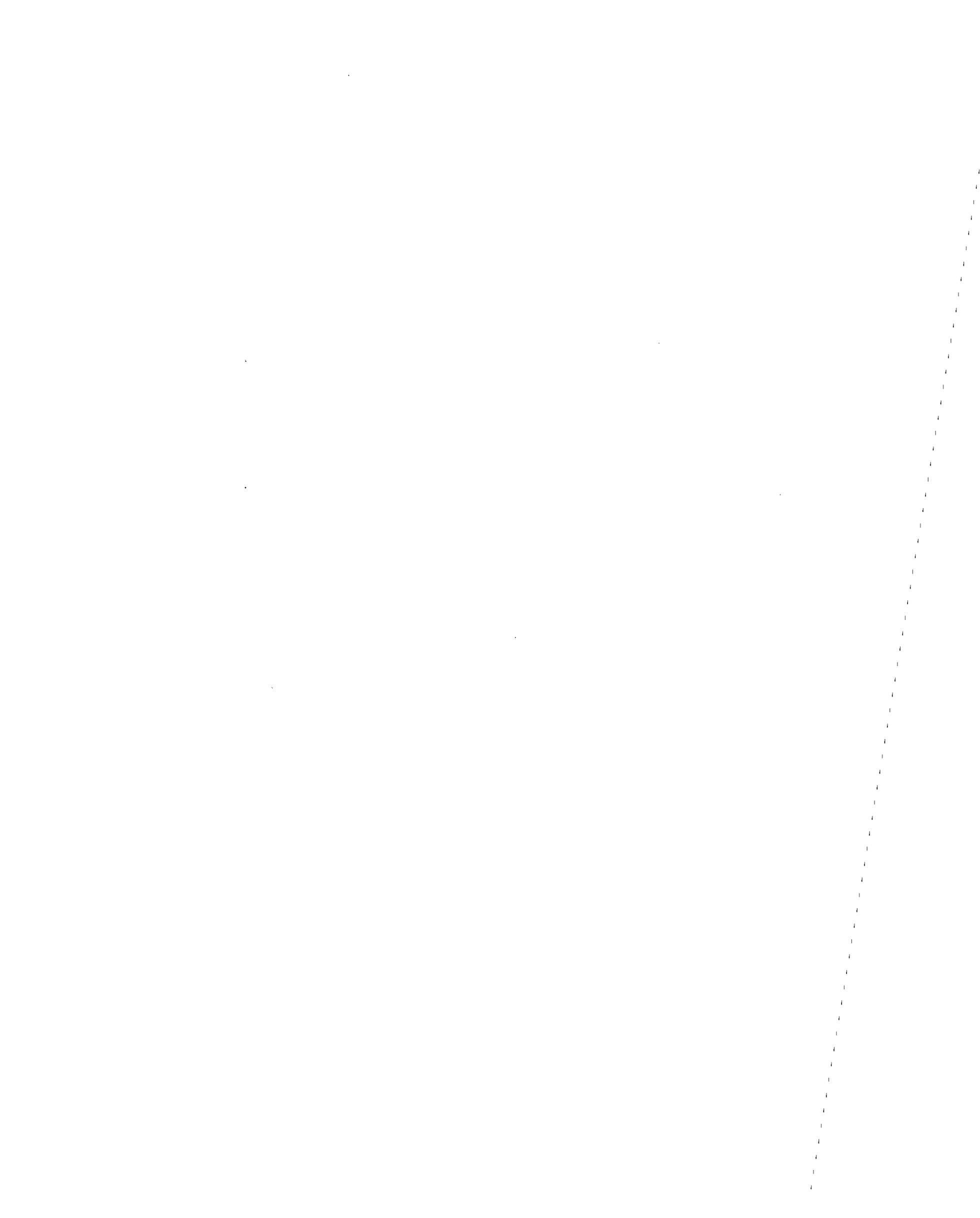


## Abstract

The Johns Hopkins University Educational Resource Center (ERC) in Occupational Safety and Health completed its twentieth year of effort in 1997. The Center supports professional degree programs in Industrial Hygiene, Occupational Health Nursing, Occupational Medicine, and Injury Prevention and Safety Science. In addition, there is a Continuing Professional Education Program which has undergone transition in leadership, but is now operating at a high level of effectiveness. Finally, the Outreach Program has always been extremely active but during this grant period has increased its emphasis on activities in Region III. The Industrial Hygiene and Occupational Medicine programs are fully accredited; this option does not exist for the Occupational Health Nursing or Injury Prevention programs at this time.

This report briefly traces the development of the ERC from its beginnings in 1977 to the current time. It is clear that NIOSH funds were fully responsible for the development of the outstanding interdisciplinary educational program that now exists. The ongoing challenge is securing sufficient funds to assist students in a time of rising costs for graduate education. Significant features of each program and significant new developments during this grant period are described herein.

An emphasis of this report is the high quality of students who have participated in the ERC educational programs and their contributions to occupational health upon graduation. The goal of this center is continued preparation of professionals who will advance this important field.



## **I. Significant Findings**

During the period 1992-1997, the Johns Hopkins Educational Resource Center has provided training at the masters and doctoral levels in the core areas of industrial hygiene, occupational health nursing, occupational medicine, and occupational injury epidemiology and safety sciences. In addition, the Occupational Medicine Program has provided residency training that fulfills the academic and practicum year requirements for board eligibility in occupational medicine. Additionally, the Continuing Education Program has provided education, focusing on the needs of practicing professionals and the Outreach Program has addressed a wider, more diverse audience, with an increase in activities in Region III. A high level of interdisciplinary interaction has been reflected in all areas of education and outreach.

The following points, by program area, are presented as a summary of the major events and developments further described in this report.

### Industrial Hygiene

- The IH Program has been accredited by the Accreditation Board for Engineering and Technology since 1990.
- Timothy Buckley, PhD, recruited to the faculty.
- Faculty continued a high level of research productivity, reflected in a high rate of peer reviewed publications and book chapters.
- Opportunities for joint degree programs being developed with the Department of Geography and Environmental Engineering.

### Occupational Health Nursing

- Recruitment for additional faculty member in progress.
- Strengthened links to the Johns Hopkins School of Nursing.
- New masters degree option - MSN/MPH joint degree program developed; can be pursued by those in occupational health nursing program.
- Graduates hold significant leadership positions in occupational health nursing

### Occupational Medicine

- Dr. Clifford Mitchell and Dr. Virginia Weaver recruited to faculty.
- Dr. Brian Schwartz appointed Director, Occupational Medicine Program and Director, Division of Occupational Health
- Courses revised with development of three course core curriculum; increased interdisciplinary emphasis.

- Required clinical rotations expanded; now include office of Maryland Occupational Safety and Health and greater emphasis in Region III.

#### Occupational Injury Prevention and Safety Sciences

- One of few programs in U.S. with academic focus on epidemiology of occupational injury.
- Added courses and special studies experiences to expand curriculum in this area.
- Developed multiple field experience sites for research training.
- Developed large databases capable of supporting occupational injury research

#### Continuing Education and Outreach

- Transition in leadership from Dr. J. Corn to Ms. D. Zerbe as Director.
- Expanded continuing education offerings during departmental Summer Institute.
- Advisory Board appointed and met.
- More innovative formats such as public forum to accompany a symposium and review course held in evenings or on weekends over several weeks.
- Increasing emphasis on outreach in Region III.

## **II. Developments by Program Area**

### **A. Background of Center**

To review the progress of the Johns Hopkins University Educational Resource Center in Occupational Safety and Health (JHU ERC) one must consider the first years of the Center and the state of occupational health activities at the school immediately prior to center initiation in 1977. There has been continuity and growth in teaching, research, continuing education, and outreach activities since 1977.

#### Pre-Center (prior to 1977):

Dr. Anna Baetjer was the primary focus of the original occupational safety and health education training and research at the School of Hygiene and Public Health. Dr. Baetjer was a physiologist/toxicologist/industrial hygienist and was a member of the Department of Environmental Medicine. Dr. Baetjer joined with Dr. Cornelius Krusé, a sanitary engineer and Chair of the Department of Environmental Health Engineering, to secure funding for an Air Pollution Training Grant beginning in 1970. This grant, along with Dr. Baetjer's experience with military medical training, formed the foundation of health and safety training at JHU. By 1970, there was already a long history of research in this area at JHU. In retrospect, prior to the advent of the ERC, the occupational safety and health program was underdeveloped, primarily due to limited staff commitment. Although training funds

provided for both student support and partial faculty salaries, the key faculty did not devote their major efforts toward safety and health training.

In 1976, the Departments of Environmental Medicine, Environmental Health Engineering and Radiation Health were combined to form the Department of Environmental Health Sciences. Dr. Gareth Green assumed the Chair of this new department and, in 1977 after competitive application review and site visit, secured a NIOSH Educational Resource Center in Occupational Safety and Health for Johns Hopkins University. The new Center was a major funding resource to permit the school to expand into the field of occupational safety and health teaching and research. Because the school was at that time (and continues to be) leveraged such that approximately 80% of its budget is associated with grants and contracts, the desire to expand into this field was thwarted until the ERC was awarded. Major personnel recruitments occurred in the first five year award period in order to initiate educational programs in the core disciplinary areas.

1977-1981 Initial Award Period:

Recruitment and program development characterized this period. All three program areas had to be built and space and facilities had to be developed. Major recruitments were:

Industrial Hygiene	Charles E. Billings, PhD. (Program Director, Industrial Hygiene Program)
Occupational Medicine	Edward A. Emmett, MD (Program Director, Occupational Medicine)
Occupational Health Nursing	Dianne Fogelman, Ph.D (Program Director, Occupational Health Nursing)
Industrial Hygiene	Morton Corn, PhD (Program Director, Industrial Hygiene & Director, ERC)
Continuing Education	Jacqueline K. Corn, Dr. Arts (Program Director, Continuing Education)

Courses in all program areas were established. The Occupational Medicine Residency was established and approved. The Occupational Health Nursing program was focused on doctoral level students, a controversial decision at the time, but one now viewed as innovative and highly relevant to graduating personnel capable of developing university faculty and the research base for the field of Occupational Health Nursing. Also, the Center for Occupational and Environmental Health was established to provide professional practice field experience for students and faculty. The Continuing Education Program and Outreach activities were started, a major innovation at the Johns Hopkins School of Hygiene and Public Health (JHSHPH) which did not engage in these activities prior to this initiative. Consistent with JHSHPH policies and funding, all newly recruited faculty either came with substantial funded research in progress, or initiated new research proposals, with subsequent funding. Thus, the research and teaching base for occupational health was laid primarily in this first five year period.

1982-1986:

This period coincided with major reductions in not only ERC funding, but also in research and training funding in all areas in which the JHSHPH was active. The School incurred deficits in 1982 and 1983. The Advisory Committee to the ERC became an Advisory Committee to the Department and

subsequently an advisory Committee to the School, with a Sub-Committee serving as the ERC Advisory Committee, as well as advisors to all occupational safety and health efforts. During this period the department targeted the private sector as a source of funds to alleviate stress caused by Federal funding reductions. By 1987, private sector funds would represent 25% of department funding, growing from 0% in 1982. Our target was then, and remains, 30% of the approximately \$15 million Department annual budget; we have leveled out at 25-27% in recent years. A substantial portion of private sector funds have been for research and student support in occupational safety and health.

Despite the adverse funding climate during this period, occupational safety and health faculty numbers expanded in these years, as did the accompanying research. Student numbers were reduced somewhat, the result of steadily increasing tuition and our inability to match this with increased student support. The reduced ERC funding substantially aggravated this situation. Of financial necessity, we reduced outreach activity and were quite active in professional practice; this strategy created modest surpluses to meet needs and to maintain expanded teaching and research activity.

The occupational medicine residency, industrial hygiene, nursing and continuing education programs matured and stabilized during these years. The nursing leadership changed, with Drs. Alice Gifford and Jacqueline Agnew assuming responsibilities, but the progress and stride were not broken.

The Occupational Safety and Health Seminar Series was institutionalized and a multitude of outstanding speakers offered seminars during this and subsequent periods. A major library in occupational safety and health was built using some annual ERC funds as well as other funds. This collection is currently housed in the new Lillienfeld Library facility at Hampton House (School of Hygiene and Public Health - West Building).

During this period Dr. Morton Corn, Center Director, served as the President, Association of University Programs in Occupational Safety and Health and as Chair, American Conference of Governmental Industrial Hygienists. Dr. Corn assumed the Center Directorship in 1981; Dr. Gareth Green was Director from 1977-80. The continuity of directorship since 1981 provided a unique opportunity to consolidate Center goals, activities and overall philosophy.

#### 1987 - 1991:

This was a period characterized by the blossoming of occupational safety and health activities throughout the school and, to a limited extent, elsewhere on the JHU campus. Perhaps the most important development was the linkage with the injury prevention effort in the Department of Health Policy and Management. Dr. Stephen Teret directed one of the first four funded Injury Prevention Centers under the Centers for Disease Control. Injury prevention, a new, exciting branch of safety science, formed the basis of the fourth ERC training core in safety science. Dr. Gordon Smith assumed the leadership role, which resulted in an application review, site visit and subsequent approval of this core program. The academic year 1990-91 was the first year this core was active as part of the ERC. It was funded on a two-year basis to coincide with the next grant renewal. A major teaching initiative stemming from this award was the introduction of the first ergonomics course, Introduction to Ergonomics, first offered in the 2nd Quarter, 1991-92, by Dr. Joanna Sznajder, Lecturer, who joined the faculty on a one-half time basis in September 1990. Dr. Sznajder's appointment was increased in 1993 to full-time.

A major recognition of the maturing of the industrial hygiene program in the period was the award of ABET accreditation to the program in 1990. The laboratory facilities of the IH Program were expanded. Links with industry and labor organizations were strengthened, bringing supplemental student funding and internship opportunities in the industrial hygiene and nursing programs and new rotations for occupational medicine residents at Baltimore Gas and Electric Company and International Association of Fire Fighters. Dr. Sheila Fitzgerald joined the faculty of the OHN Program as an Assistant Professor, and a closer relationship was developed with the relatively new School of Nursing. The Continuing Education Core started the Summer Institute in Environmental Health Sciences in 1987, permitting intensive study for professionals with the award of academic credit. Over this period, changes took place in school philosophy that eased the barriers to participation in degree programs - a part-time MPH option became available and course offerings at off-campus locations increased.

#### 1992-Present:

During this period a change in management philosophy literally swept through U.S. private and governmental organizations. It was characterized by downsizing and outsourcing of personnel and greater efficiency of operation. The impact on universities was major, as reflected by the following:

- reduction of Federal and private sector research funds making it difficult for universities to sustain the level of research activity built up over decades.
- increased competition among faculty to obtain research funding, making it difficult to attract and retain qualified faculty.
- increased numbers of applicants seeking improved credentials in a more competitive job market.
- a major increase in the availability and demand for consultation services in the occupational safety and health field, as contrasted to full-time staff professionals delivering these services as organization employees.
- increased emphasis on community and employee right-to-know in the presence of continuing regulatory reform and decreased emphasis on regulatory enforcement.

The net effect of these impacts was to stimulate a reassessment of activities at universities. At the School of Hygiene and Public Health a five year plan was developed that established goals in professional education, practice and research. The planning effort was initiated by a new Dean of the School, Dr. Alfred Sommer, who assumed the Deanship in 1991, and has been implemented and updated since its adoption in 1993. In 1993 Dr. John Groopman was appointed Chair, Department of Environmental Health Sciences, succeeding Dr. Gareth Green. Dr. Groopman has been a strong supporter of the NIOSH ERC and places a major departmental emphasis on occupational safety and health programs. The implementation of the five year plan has resulted in increased emphasis on teaching, with satellite campuses in Montgomery County, Downtown Baltimore and Washington, D.C. This is an effort to accommodate students interested in part-time professional education and has been highly successful. The trend to part-time, as contrasted to full-time study, can be observed in the ERC programs in Industrial Hygiene and Safety Science, Occupational Health Nursing and Injury Epidemiology. In research, the implementation of the five-year plan has resulted in an increased

emphasis on collaboration, “partnering” and sharing of resources to optimize the effectiveness of resources. Throughout this period the NIOSH ERC has maintained or expanded its efforts in all program areas. A change occurred in the leadership of the Continuing Education program, with the program now under the leadership of its new Director, Diane Zerbe, MHS. In addition, the research output of the ERC programs has also been maintained or increased, depending on program. The Industrial Hygiene program, in particular, has increased doctoral graduates and students substantially during the period of this award (1992-96).

During the current award period the JHU ERC appointed an Advisory Board dedicated to the ERC, as contrasted to the previous practice of the ERC utilizing the services of selected members of the School of Hygiene and Public Health Advisory Board. The initial appointees to the Board and their positions at the time of their appointment were:

Eric Sansone, PhD (now retired)	Director of Health, Safety and Environment Program Resources National Cancer Institute Frederick, MD
Richard Boggs, PhD	Vice President Organization Resources Counselors Washington, DC
Arnold Kaminer, MD	Associate Medical Director IBM White Plains, NY
Judith Baigis-Smith, PhD	Associate Dean for Research and Scholarship Georgetown University, School of Nursing Washington, DC
John Moran	Director Laborers’ Health and Safety Fund Washington, DC
Earl Heath	Safety and Health Consultant (Former Director, OSHA Training/ Education Office) Towson, Maryland

The Board has been a major resource for the ERC Director and Program Directors. Board members have developed a sense of involvement in the ERC and are thoroughly familiar with its activities.

In 1993 and in each subsequent year, an ERC faculty/student meeting of all students in programs, regardless of support has been held at the beginning of the academic year to fully familiarize students with ERC program history, the JHU ERC program faculty and students, activities, etc. This session has proven to convey information, and also to establish a foundation for continued

student/faculty interaction early in the academic year. It also promotes a sense of shared values and interests among all those in the ERC.

The ERC faculty have always been involved in outreach activities. Consistent with the new guidelines for ERCs we have been attempting to develop increased outreach in Region III, as contrasted to substantial outreach by faculty in national and international arenas, the latter activities consistent with the School in its role as the major international/national school of public health. Our faculty are developing significant regional outreach affiliations.

Major personnel changes or changes in responsibilities of ERC faculty during the period 1992-97 were the following:

- Patrick Breyse, PhD became Director, Industrial Hygiene Program succeeding Dr. David Swift.
- Brian Schwartz, MD became Director, Occupational Health Division and Director of the Occupational Medicine and Residency Programs, succeeding Dr. J.Nethercott.
- Diane Zerbe, M.H.S became Director, Continuing Education program, succeeding Jacqueline K. Corn, DA
- Clifford Mitchell, MD, was appointed Assistant Professor, Occupational Medicine
- Virginia Weaver, MD was appointed Assistant Professor, Occupational Medicine.
- Timothy Buckley, PhD was recruited as Assistant Professor, Division of Environmental Health Engineering, and joined the ERC Industrial Hygiene faculty.

The close of this grant period brings a change of Director and Deputy Director, precipitated by the planned phased retirement of the Director, Dr. Morton Corn, commencing July 1, 1997. Dr. Jacqueline Agnew, having served as Deputy Director to Dr. Corn for three years, and being familiar with all aspects of ERC activities and the role of the Director, will assume the Directorship. Dr. Corn plans to continue his association with the School and the ERC on a one-half time basis, participating in research and teaching during the 1997-98 academic year. The new Deputy Director, Dr. Peter Lees, is a key member of the Industrial Hygiene faculty and thoroughly familiar with the ERC programs and faculty.

## **B. Industrial Hygiene**

### **1. Organization and Faculty**

The Industrial Hygiene Program (IHP) is located in the Division of Environmental Health Engineering (EHE) in the Department of Environmental Health Sciences of the School Public Health. The IHP Director is Dr. Patrick N. Breyse, who took over this responsibility from Dr. David L. Swift in 1993.

The EHE Division has six full-time faculty and ten affiliated faculty. Full-time faculty include Drs. Morton Corn, Patrick N. Breyse, Timothy Buckley, Peter S.J. Lees, Joanna Dankiewicz-Sznajder, and David L. Swift. These faculty represent a diversity of highly specialized scientists who coordinate their scientific expertise and professional skills to solve problems in occupational safety and health. Faculty research focuses on the development of techniques for the systematic evaluation, quantification, and control of risk associated with exposure to environmental agents. The research interests and areas of the full-time and affiliate faculty are summarized in Table 1. The six full-time faculty commit essentially 100% effort to the Industrial Hygiene Program. The core faculty include two Certified Industrial Hygienists (CIH; certified in comprehensive practice), a Certified Safety Professional (CSP), and a Certified Professional Ergonomist (CPE).

Even though most areas of teaching are adequately covered by the IHP core faculty, there are a number of areas for which the development of courses by core faculty would be inefficient in the research-oriented atmosphere at the Johns Hopkins School of Public Health. For these purposes, affiliated faculty who are practicing professionals, provide a valuable resource for student education and training by teaching courses or giving lectures in their specific area of expertise. These affiliated faculty, also listed in Table 1, not only bring their expertise in the subject material, but also contribute their practical experience and insight in addressing short and long term needs in occupational health and safety.

In addition to the commitment and breadth of the IHP core faculty and the overall depth of faculty expertise at the School of Public Health and in the University as a whole, particularly in areas of interest to our students, is a major programmatic strength. These subject areas include, toxicology, physiology, radiation health sciences, epidemiology, biostatistics, health policy, biochemistry, and reproductive biology. The Johns Hopkins School of Public Health is the largest such institution in the U.S. and the world; its size, reputation, and breadth of interests give the IHP students a unique opportunity to experience an academic setting with a strong emphasis on training, research, and public service. In addition, the Department of Geography and Environmental Engineering in the School of Engineering offers expertise and courses in hazardous waste remediation and engineering.

Since the last five-year renewal, three faculty members have left the Division. Dr. Frank retired and is currently professor emeritus, Drs. Hanna and Francis have left the University and are currently working for environmental consulting firms. Dr. Hanna remains affiliated with the IHP as an adjunct assistant professor and Dr. Francis gives lunch-time seminars. These losses have been balanced by the addition of Drs. Dankiewicz-Sznajder and Buckley. In addition, as an emeritus professor, Dr. Frank still teaches and advise students.

The strength and reputation of the full-time core faculty in industrial hygiene is evidenced by their significant local, national, and international professional activity. The faculty's high level of research productivity is evidenced by published papers, review articles, and book chapters, primarily in the field of occupational health and safety. These publications are augmented by numerous presentations at national and international conferences and participation on professional committees of the AIHA and ACGIH and other national and international organizations, as well as extensive professional involvements.

Faculty research interests address many aspects of the environment-disease continuum, including source characterization, exposure/dose assessment, and control technologies. In doing so, many of the research priority areas identified by NIOSH in the National Occupational Research Agenda (NORA) are addressed, as indicated in Table 2.

## 2. Masters Academic Program

The required courses for the one and a half year Masters of Health Sciences (MHS) Program in Industrial Hygiene are listed in Table 3. Masters level training involves course work in a wide variety of industrial hygiene subjects as well as courses in other core ERC disciplines and in disciplines such as physiology, toxicological sciences, epidemiology and biostatistics. As previously noted, this program is Accredited by the American Board for Engineering and Technology. In addition to the course work, students are required to submit an essay to complete the MHS degree. This essay is usually based on work performed during a summer internship.

Since the last grant period, the IHP has had the following curriculum changes:

- Occupational Health, the 4th term field trip course has been made more interdisciplinary with the addition of instructors from the IHP (Drs. Lees and Breyse) and nursing (Dr. Agnew) and injury prevention (Dr. Smith). This course was also reduced from 8 to 5 credits.
- The courses on Noise (3 credits) and Physical Agents (3 credits) were combined into a 4 credit course entitled Noise and Other Physical Agents in the Environment (Dr. Breyse instructor).
- A new course, Special Topics in Industrial Hygiene (4th term, 3 credits), has been developed (Drs. Lees and Breyse instructors).
- The EHE seminar series has been added as a special studies credit requirement for all students.

In the next five year training period we will further develop the joint degree opportunities with the Department of Geography and Environmental Engineering. In addition, a new "Special Studies - Interdisciplinary Interaction" requirement is being developed in an effort to continue to improve student interaction between core programs. We are also exploring the formalization of part-time masters program. At the present time, students wishing to pursue a part-time program must take the majority of their courses during working hours and as a result, it is difficult to complete the program on a part-time basis. We therefore have a limited number of part-time students in the program. The challenges to formalizing a part-time program include finding faculty to teach courses during the weekends and evenings, finding money to pay them, and determining a mechanism to ensure interdisciplinary interaction with other core programs.

The numbers of graduates from the IHP over the last five years have ranged from 6 to 13. The number of students enrolling in the IHP masters program during the last five years has ranged from 7 to 12 per year.

Funding for student support remains the biggest challenge to the IHP program. Sources of funding in addition to the NIOSH fellowships (1 doctoral tuition only, 2 masters tuition plus stipend) include the following:

- The Department contributes 85% tuition scholarship for the 5th and 6th terms of the masters program;
- Department of Energy Fellowships;
- Industrial Hygiene Foundation Award (approximately \$1500 annually);
- Environmental Health Engineering Student Development Fund (current balance is approximately \$70,000 which results in a \$2500 annual award);
- Sponsored projects and professional practice; and
- Employer support (for example, DOD and Exxon Corporation have paid for employees to attend our Program).

Plans for the future include increasing the EHE Student Development Fund and exploring other funding opportunities.

### 3. Doctoral Program

The objective of the research training program in industrial hygiene is to graduate highly qualified doctoral students in the various research areas represented by the faculty. Graduates from the doctoral programs in the School of Public Health are intended to be prepared to enter research careers in one of several areas including universities, research institutes, governmental health agencies, and international health organizations. Faculty members in the School of Public Health are all expected to have a heavy involvement in research efforts, advising doctoral students and publishing scholarly works in books, peer reviewed journals, and technical reports. Promotion and tenure decisions at the School are heavily weighted toward research productivity and faculty are expected to raise a significant fraction of salary support from research grants and contracts. Thus the entire atmosphere of the school and department emphasizes research, and it is considered an important component of the academic mission of the ERC program in industrial hygiene.

Doctoral training in industrial hygiene can result in the PhD or DrPH (Doctor of Public Health) degree. The DrPH degree is for students with significant professional experience who are interested in a broad course of study and a requires a dissertation with a policy orientation. The distinction between PhD and DrPH is not often clear however, and as a result the School is in the process of reviewing the DrPH degree. Completion of a doctoral degree requires 4-5 years. Students admitted to the IH doctoral program are expected to complete, or have completed, the equivalent of the MHS curriculum. Additional coursework is based on the research area focus of the student and is designed on an individual basis by the student's advisor with input from the Divisional faculty and the student's doctoral committee. During the last five years the IHP has graduated 11 Doctoral students.

The presence of the ERC has greatly stimulated interdisciplinary research at JHU. IHP faculty collaborate with Occupational Health Nursing, Occupational Medicine, and Injury Epidemiology faculty.

This level of interaction and resulting synergism is a direct result of the ERC and cooperative program development activities.

#### 4. Contribution to the discipline

A special contribution of the IHP research program is the provision of an environment with extensive interdisciplinary opportunities and ability to address the entire continuum of the “environment-disease” spectrum. These opportunities include inter-ERC, as well as school-wide collaborations. As mentioned earlier, the large size of the School and the strong emphasis on research makes the IHP a unique environment for research and doctoral studies. The importance of collaboration and interdisciplinary research is well accepted in the Department and the School. As a result, the School’s faculty are readily willing to assist students by serving as informal advisors, committee members, and by providing laboratory resources. For example, faculty members routinely share analytical resources and capabilities with other faculty members and students.

Of special note is the role of the IHP faculty and doctoral students in providing an exposure assessment resource to health effects studies. By providing detailed exposure assessment capabilities to other investigators at the School it is possible to provide a better understanding of what it means to be exposed relative to disease risk. Examples of recent large scale health effects studies in which IHP faculty have provided detailed exposure assessments include the following:

- Study of leukemia and ELF field exposure in telephone linemen;
- Retrospective study of chromate exposure and lung cancer risk;
- Chemical/noise exposures and hearing loss in pharmaceutical workers;
- Nickel exposures and non-malignant pulmonary disease;
- Study of reproductive outcomes in the semiconductor manufacturing industry;
- Exposure assessment for a nation-wide cohort of paper manufacturing workers;
- Exposure assessment for a study of lab animal allergy and asthma; and
- Exposure of miners and home dwellers to radon progeny.

#### 5. Program support

The IHP research activities receive extensive support from other sources. We currently have 12 doctoral students in the program. Only one of them receives support from the NIOSH ERC Training Grant. Other sources of support include the School, Department, employers, and sponsored projects. Examples of current sources of funding for research activities include: the Center for Indoor Air Research, the Nickel Producers Environmental Research Association, American Forest and Paper Association, VDT Health Research Foundation, Department of Energy, Environmental Protection Agency, National Institute of Environmental Health Sciences, and U.S. Air Force.

#### 6. Evaluation of Training Effectiveness

In order to evaluate the effectiveness of the IHP we have reviewed the numbers of students graduating, graduate employment history, the proportion of graduates staying in the field, and the numbers of graduates that become CIHs. In order to help in the evaluation of the IHP, we have begun to develop a data base of all graduates from the EHE Division. This data base, which is independent of the alumni office tracking, will help us track alumni employment, certification status, and other variables.

The number of students graduating from the program has increased during the last five years. During the previous 5 year grant period the number of graduates averaged 5 per year, while during the last five year period the number of masters graduates increased to an average greater than 8 per year. It should be noted that only 2-3 masters students receive NIOSH support each year. The remainder of students come with employer support, come with a Department of Energy Fellowship, or provide their own support (approximately \$45,000 for the 1.5 year program). The fact that approximately 75% of the masters students are supported by non-NIOSH sources is a strong testament to the effectiveness of the IHP. The effectiveness of the program is internationally recognized. During the last five years we have had masters students from Argentina, Japan, Taiwan, St. Lucia, Sri Lanka, Singapore, and Canada.

Graduates of our program do not encounter a problem finding jobs. Of the 41 masters graduates during the last five years 35 out of 41 (85%) of the graduates are currently employed in the field or continuing their studies at the doctoral level. Of those not employed (a total of 6), 2 are temporarily out of the workforce (due to childbirth and a short-term spousal relocation), 1 is applying for medical school, 1 is unemployed and looking for a job, and the employment status of the remaining 2 individuals is uncertain.

The effectiveness of the IHP is also indicated by the high proportion of graduates that have become certified. Seventy percent of the masters graduates from the period 1984 - 1991 are currently certified (CIH). This analysis does not include recent graduates (years 1992 - present) because it takes five years of experience to qualify for the certification exam and many of our graduates entered our program with little work experience.

The effectiveness of the IHP is evaluated internally at regular faculty meetings and EHE Divisional retreats. The most recent Division retreat was in 1993. Internal review is also provided by other ERC faculty during ERC faculty meetings and retreats, the most recent ERC faculty retreat was in the spring of 1995. External review of the IHP is provided by the ERC Advisory Board, which met most recently in spring 1996. Results of these reviews include changes in curriculum and course content, as well as the identification of interdisciplinary interaction and continuing education opportunities.

At the end of each 1.5 year cycle, we solicit feedback from graduating students and ask them to provide us with comments and criticism. Our students are not shy about letting us know what we do well and where the program can be improved. We also solicit input from alumni during the JHU IHP annual alumni reception at the American Industrial Hygiene Association Conference and Exposition. In general, recent graduates and alumni provide very positive feedback on the quality of training received at JHU. Some of the recent changes in the IHP curriculum, i.e., the creation of the special topics course and the combining of noise and physical agents into one course, were based on student comments.

In addition to the above, the American Board for Engineering Technology (ABET) accreditation conducted an extensive review of the masters IHP in 1992/93. This review required a two volume written submission (approximately 300 pages) and a two day site visit. This review resulted in a program reaccreditation for a six year period (1993 - 1999).

In conclusion, the effectiveness and high quality of the IHP program is attested to by the increased number of graduates, the ability to attract students with non-NIOSH support, and the positive feedback from graduates and alumni, the high proportion of graduates that become certified, and the 6-year ABET reaccreditation.

**Table 1 Listing of IHP faculty, their appointments, and areas of expertise/research interests.**

Name	Appointments	Area of Expertise/Research Interest
<b>Full-Time Faculty</b>		
Morton Corn, PhD. CSP*	Professor, Director of Division Environmental Health Engineering, Former Director of NIOSH ERC	risk assessment, safety and health management, exposure assessment, asbestos and other fibers, and allergens
Patrick N. Breyse, PhD, CIH**	Associate Professor, Industrial Hygiene Program Director, Associate Director of Center for VDT and Health Research	exposure assessment, airborne fiber exposure assessment, air cleaning adsorbents, noise, non-ionizing radiation, and airborne allergens
Timothy Buckley, PhD	Assistant Professor	total exposure, biomarkers, and air pollution
Peter S.J. Lees, PhD, CIH	Associate Professor, Deputy Director of NIOSH ERC (1997)	exposure assessment for retrospective epidemiology, surface contamination, man-made vitreous fibers, and lead
Joanna Dankiewicz-Sznajder, PhD, CPE***	Instructor	ergonomics and injury prevention
David L. Swift, PhD	Professor	aerosol science, airflow and ventilation, particle deposition and vapor uptake in the respiratory tract, and respiratory protection
<b>Affiliated Faculty</b>		
David Blum, JD	Departmental Associate	occupational safety and health law
Stephen M. Bowes III, PhD, CIH	Adjunct Assistant Professor	general industrial hygiene, ventilation
Henry Chajet, JD	Departmental Associate	occupational safety and health law
Linda Hanna, PhD	Adjunct Assistant Professor	risk assessment, hazardous waste
Warren Muir, PhD	Departmental Associate	environmental policy
David Sliney, PhD	Departmental Associate	physical agents, lasers
Alice Koegel, MHS, CIH	Departmental Associate	general industrial hygiene, hazard communication
Peter Zimmerman, JD	Departmental Associate	environmental law
Michael Snead, CIH	Departmental Associate	industrial hygiene management, general industrial hygiene
Byron Tepper, PhD	Adjunct Associate Professor	biohazards, hospital safety

\* CSP - Certified Safety Professional

\*\* CIH - Certified Industrial Hygienist (Comprehensive Practice)

\*\*\* CPE - Certified Professional Ergonomist

**Table 2 Summary of recent faculty research involvements and their corresponding NORA category.**

NORA Category	Faculty Member	Research Project
<b>Disease and Injury</b>		
Asthma and COPD	P. Breyse M. Corn P. Breyse	Nickel-induced non-malignant lung disease Lab animal allergen exposure assessment Antigen/carpet retention studies
Fertility and Pregnancy Abnormalities	M. Corn	Reproductive effects of ethylene glycol exposure
Hearing Loss	P. Breyse P. Lees	Smoking/chemical exposures and hearing loss Noise exposure to headset-wearing communication workers
Musculoskeletal Disorders	J. Sznajder	Investigation of valve turning tasks in a refinery
<b>Work Environment and Workforce</b>		
Emerging Technologies	P. Breyse	Non-ionizing electromagnetic radiation (ELF fields) exposure research
Indoor Environment	P. Breyse P. Lees D. Swift D. Swift	Photocopier emission modeling Environmental tobacco smoke exposure Tobacco smoke exposure research Radon exposure assessment
Mixed exposures	P. Breyse	Smoking and chemical exposures and hearing loss
<b>Research Tools and Approaches</b>		
Control Technology and PPE	P. Breyse P. Lees	Activated carbon adsorption research Evaluation of glove integrity in a flow cytometry laboratory
Exposure Assessment Methods	P. Lees/M. Corn/ P. Breyse  D. Swift T. Buckley P. Lees	Airborne fibers (asbestos and man-made vitreous fibers) exposure assessment/Methods of conducting retrospective exposure assessments for epidemiologic studies. Particle deposition modeling and sampler evaluation studies Biomarkers for exposure and total exposure research Dermal exposure assessment and surface contamination research

<b>Table 3 Required and elective courses for IH MHS Program (1.5 years - 6 academic terms).</b>		
<b>Term</b>	<b>Course</b>	<b>Credits</b>
1st Term	Principles of Epidemiology (340.601)	5
	Introduction to Biostatistics (140.601)	5
	Principles of Occupational Safety (182.631)	2
	Principles of Toxicology (187.610)	4
	EHE Seminar (182.840)	1
2nd Term	Fundamentals of Human Physiology (183.631)	4
	Basic Biostatistics - Inference (140.602)	4
	Principles of Industrial Hygiene (182.625)	4
	Introduction to Ergonomics (182.621)	4
	Historical Analysis of Occ. Health Policy (182.629)	2
	EHE Seminar (182.840)	1
3rd Term	Industrial Hygiene Laboratory (182.614)	5
	Airborne Particles (182.615)	3
	Occupational Safety & Health Management (182.623)	3
	Basic Biostatistics - Statistical Modeling (140.603)	4
	EHE Seminar (182.840)	1
4th Term	Industrial Ventilation Controls (182.622)	4
	Occupational Health (188.681)	5
	Special Topics in Industrial Hygiene (elective - to become required)	3
	EHE Seminar (182.840)	1
	Electives	3
5th Term	Introduction to Radiation Health Sciences (186.601)	5
	Electives/Special Studies Research (182.840)	10
	EHE Seminar (182.840)	1
6th Term	Noise and Other Physical Agents in the Environment (182.637)	4
	Occupational Safety and Health Law (182.633)	3
	Electives/Special Studies Research (182.840)	8
	EHE Seminar (182.840)	1

TABLE 3 continued:

Commonly Selected Electives

Occupational Epidemiology (340.609)

Environmental and Occupational Health Policy (303.664)

Psychosocial Work Environment and Health (306.733)

Molecular Dosimetry and Biomarkers (180.6504)

Issues in Injury Control (304.683)

Safety and Health in the Research Laboratory (182.630)

Environmental Health (180.601)

Fundamentals of Occupational Health (188.680)

Occupational and Injury Prevention and Safety Practice (304.688)

Health Effects of Indoor and Outdoor Air Pollution (183.641)

## C. Occupational Health Nursing

### 1. Organization and Faculty

The following are the core faculty of the Occupational Health Nursing (OHN) Program:

Jacqueline Agnew, MPH, PhD, COHN, FAAN  
Associate Professor, Program Director  
Deputy Director, ERC [Director, 1997]  
Joint appointment, School of Nursing

Sheila T. Fitzgerald, CRNP, MSN, PhD  
Assistant Professor  
Joint appointment, School of Nursing

The OHN Program is located in the Division of Occupational Health, Department of Environmental Health Sciences, where Drs. Agnew and Fitzgerald hold primary appointments. Several disciplines are represented in the Division, including nurses, physicians, epidemiologists, and laboratory scientists. The result is an interdisciplinary climate that is well suited for training in the prevention, intervention, and research of occupational health problems. The OHN Program's location facilitates interaction with faculty and students of the Occupational Medicine Program within the division and with those in the Industrial Hygiene Program within the department. The ERC also provides a strong link with members of the Occupational Injury Epidemiology Program which resides in the Department of Health Policy and Management.

Recruitment for another tenure track faculty position in occupational health nursing has been approved and a search is currently under way. This recruitment effort has strong support at the division, department, and school levels at a time when new tenure track positions are very carefully considered and must be approved on a case-by-case basis. We seek a nurse who is prepared at the doctoral level and who would be eligible for an appointment as an Assistant Professor. Such an addition would increase the research, teaching, outreach, and continuing education activities of the program and would make it possible to actively recruit a greater number of students.

At this time, two occupational health nurses, Drs. Winifred Hayes and Anita Schill, hold Associate appointments in the division, providing input into the OHN program and additional resources for student assistance. Their contributions have been particularly valuable while the search for an additional faculty member has been under way. Additional Associate appointments are currently being initiated. This is a successful mechanism for augmenting the faculty resources of the Program.

In addition, we enjoy substantial interaction with faculty of the Johns Hopkins School of Nursing. Three faculty members involved in the Joint MSN/MPH Program, Drs. Jacqueline Dienemann, Jacquelyn Campbell, and Joan Kub, work with OHN students in that program, and several faculty work with OHN students based on their relevant areas of research. An example is joint advising taking place by Dr. Karen Huss and Dr. Fitzgerald with a student who is interested in occupational latex sensitivity. Dr. Huss is an expert in immunological effects of exposures and is also experienced in the topic of occupational asthma.

The following summaries briefly present the core OHN faculty's breadth of teaching and administrative activities related to academic training.

Dr. Jacqueline Agnew

As the Director of the OHN Program, Dr. Agnew directs and oversees all aspects of the Occupational Health Nursing Program. She recruits and advises master's and doctoral level students, directs course credit offerings in occupational health nursing, monitors student progress, and coordinates budgetary and administrative matters related to the program. Additionally, she directs the course titled "Advanced Topics in Occupational Health Nursing." She represents the Division of Occupational Health on the department Educational Programs Committee. Dr. Agnew served as an elected member of the school Faculty Senate. During this grant period, she also served on the school MPH Admissions Committee and, at the university level, on the advisory board of the Faculty and Staff Assistance Program (Johns Hopkins employee assistance program). Dr. Agnew holds responsibility for several division duties, particularly those related to the Division of Occupational Health doctoral program. She coordinates the application review process, advises students, and participates in policy decisions regarding program and curriculum requirements and monitoring of student progress. Dr. Agnew represented the School of Hygiene in the development of a joint MSN/MPH Program and now chairs the Steering Committee of that degree program. She is also an Associate Director of the Johns Hopkins Center on VDT and Health Research.

Dr. Sheila Fitzgerald

Dr. Fitzgerald works with MPH and doctoral candidate OHN students while conducting her research and performing many administrative duties. She recruits students at both the masters and doctoral levels and advises them on their curriculum, supervises them in independent studies, organizes and directs the OHN Seminar series, and co-directs the course "Advanced Topics in Occupational Health Nursing." Dr. Fitzgerald was selected by the Dean to be the Principal Investigator of the Division of Nursing Training Grant for the School of Hygiene. Dr. Fitzgerald is a nurse practitioner, credentialed to practice at the Johns Hopkins Center for Occupational and Environmental Health. She holds a joint appointment at the Johns Hopkins School of Nursing where she commits a percentage of her time to teaching and precepting undergraduate and graduate nursing students. She teaches physical assessment in a course titled "Dimensions of the Nursing Role," using the COEH Clinic for a clinical teaching site, and "Health Assessment and Measurement" in the graduate advanced practice program. Dr. Fitzgerald has developed a course titled "Occupational and Environmental Health," which is jointly sponsored by the School of Nursing and the School of Hygiene. This new course is offered in the Spring to graduate students from both schools and to senior School of Nursing students. The content provides the grounding required for "Advanced Topics in Occupational Health Nursing" for students who have not taken the course curriculum in the Occupational Health Nursing Program.

Supporting Faculty

The range of expertise represented by the OHN faculty makes it possible to offer high quality classroom, field, and research experiences for students enrolled in the program. Supporting faculty for the OHN Program include the remaining Division of Occupational Health faculty, including the Occupational Medicine ERC faculty (described in the Occupational Medicine section) and faculty with joint appointments in the division. Subject areas thus represented are psychology, epidemiology, molecular biology, toxicology, international health, environmental medicine, and the history of occupational health, in addition to nursing and medicine. All division faculty are accessible to OHN students for individual consultation or independent advising for credit (known as "Special Studies").

Faculty interact with OHN students in ERC and division seminars, journal club, research seminars and grand rounds. They also serve on students' doctoral research committees. Other supporting faculty (e.g., toxicologists, physiologists, radiation scientists) are available within the other divisions of the Department of Environmental Health Sciences. Additional faculty participation comes from the two remaining ERC programs - Industrial Hygiene and the Occupational Injury Epidemiology Program.

Faculty who hold joint appointments in the Division of Occupational Health make significant contributions to the OHN Program. Of note are three members of the Department of Health Policy and Management, Drs. David Celentano, Barbara Curbow, and Jeffrey Johnson, all of whom teach, conduct research, and advise students on topics related to the health of workers. Additionally, Dr. Jonathan Patz, with a primary appointment in the Department of Molecular Microbiology and Immunology, holds a joint appointment in the Division and works with students in the area of environmental health policy. Other faculty hold joint appointments in the Department of Environmental Health Sciences and participate in the OHN program.

Faculty of the Johns Hopkins School of Nursing also work with the faculty and students of the OHN Program. School of Nursing faculty represent areas of nursing expertise that are highly relevant to occupational health such as violence, infection control, rehabilitation, health care management, immune responses and health promotion. OHN faculty collaborate with School of Nursing faculty on occupational health research topics of mutual interest. At this time, there are three MPH graduates of the OHN Program who are full time faculty members of the School of Nursing and thus provide strong links between the schools.

Of core and supporting faculty mentioned above, only Drs. Agnew and Fitzgerald now receive ERC funding support from the OHN budget. Our plan is to enhance faculty resources by recruiting an additional faculty member, partially funded by the ERC, who would be committed to the OHN Program. Because long term faculty sustainment depends on establishing adequate external sources of support for all program faculty, we will continue to build individual research programs and seek external sources of support.

The OHN faculty have demonstrated leadership in occupational health nursing through research, publications in peer reviewed literature, invited presentations, consultations, and membership in professional organizations and on national committees. They bring to this program strong backgrounds and reputations in nursing, public health, and several areas of research. Table 4 summarizes the competency areas of the core and supporting faculty. Details about the expertise of supporting faculty may be found in the Occupational Medicine section of this report.

TABLE 4. Areas of expertise and research interests of faculty

CORE FACULTY:	AREAS OF EXPERTISE/RESEARCH
J. Agnew, RN, MPH, PhD	aging workers, cumulative trauma disorders, occupational stress
S. Fitzgerald, RN, MSN, PhD	health promotion, cardiovascular rehabilitation, occupational asthma, adolescent workers
SUPPORT FACULTY:	
J. Corn, DA	occupational and environmental health history
C. Mitchell, MD, MPH, MS	medical surveillance, occupational and environmental health policy, repetitive-motion related disorders
J. Patz, MD	health effects of global climate change, environmental health policy
R. Rubin, PhD	occupational and environmental toxicology, risk assessment
B. Schwartz, MD, MS	occupational epidemiology, Lyme disease, neurotoxic effects of lead and solvents, exposure assessment
P. Strickland, PhD	molecular epidemiology occupational cancer, molecular dosimetry of combustion product exposure, UV induced DNA damage in skin
M. Tockman, MD, PhD	occupational respiratory disease, lung cancer biomarkers
V. Weaver, MD, MPH	occupational epidemiology, biomarkers, surveillance
ASSOCIATE FACULTY:	
W. Hayes, RN, MSN, PhD	occupational injury prevention, occupational health management
A. Schill, RN, MPH, PhD	musculoskeletal injuries, psychosocial work factors, occupational health policy

## 2. Masters Academic Program

Training at the Master's level in the Occupational Health Nursing Program at Johns Hopkins centers on the Master of Public Health (MPH) degree program. Additionally, the development of the joint degree program as a venture with the Johns Hopkins School of Nursing now makes it possible to offer the MSN/MPH degree program as an expanded option. This is a significant and outstanding program advancement that has occurred during the previous grant period and makes possible a degree program in occupational health nursing that is available at only one other institution we know of in the country.

### Master of Public Health (MPH)

The Johns Hopkins ERC offers a rich educational environment for nurses who are preparing for leadership positions in occupational health. Based in the largest school of public health in the world, the OHN Program curriculum benefits from the comprehensive selection and teaching excellence that is characteristic of the school's course offerings in the public health sciences and related topics. Additional strength comes from the opportunities provided specifically by the ERC to offer depth and breadth in course offerings in occupational and environmental health, as well as field opportunities and a high level of interaction with the other occupational health disciplines. It should be added that the OHN Program faculty, through courses offered in occupational health nursing and through lectures in other courses,

have increased the exposure and educational opportunities in occupational health for non-ERC students in this school and university.

The MPH Degree program requires completion of 80 credit units and as a full-time program spans 11 months (five terms). The program may be completed over a three year period if enrolled in part-time status. Since the part-time option has been available, it has become a popular choice of nurses, who very often must continue to work while pursuing graduate education. Admission requirements for the MPH Program include two years of health-related work experience; students typically have many more years as evidenced by the median age of the MPH class which is always greater than 30 years of age.

Masters level course requirements combine the MPH core with relevant courses in occupational health as indicated in the tables below.

TABLE 5. Required Courses: Master of Public Health Degree

NUMBER	COURSE TITLE	UNITS
221.637	Health Information Systems	2
550.605	History of Public Health	1
300.603	Social & Behavioral Aspects of Public Health	4
140.607	Introduction to Computing	3
140.601	Introduction to Biostatistics	5
340.601	Principles of Epidemiology	5
260.601	Biological Basis of Public Health	4
180.601	Environmental Health	4

TABLE 6. Required Courses: Occupational Health Nursing Program

NUMBER	COURSE TITLE	UNITS
188.680	Fundamentals of Occupational Medicine	3
187.610	Principles of Toxicology	4
182.625	Principles of Industrial Hygiene	4
188.684	Clinical Occupational Medicine	4
188.681	Occupational Health	5
188.694	Advanced Topics in Occ. Health Nursing	2
	and at least one of the following:	
304.683	Issues in Injury Control	2
182.631	Principles of Occupational Safety	4

182.621	Introduction to Ergonomics	4
305.615	Occupational Injury Prevention and Safety Practice	2

Course offerings within the School of Hygiene, particularly those in the MPH core, are constantly monitored so that the curriculum can be updated or revised according to developments in the field. An innovative course that is now part of the MPH core curriculum is 550.608, Problem Solving in Public Health: An Overview (4 credit units). In this highly recommended course, students work in interdisciplinary groups to study various approaches to actual public health problems. Another innovative course, now mandatory in the MPH degree Program, is 550.863, MPH Educational and Professional Goals Analysis (1 credit unit) in which students work with their advisors to systematically define and evaluate their professional and educational goals. A tentative curriculum is then mapped for the academic year and is designed to develop the competencies judged appropriate for the career goals of the student. Students in the OHN Program who have completed this course have found it extremely helpful because it stimulates thought and discussion which lead to the selection of the most beneficial curriculum choices.

Although the MPH curriculum does not require completion of practicum or field experiences, these are available to students and often are pursued. Experiences are tailored to students' goals. Options encompass a diverse range of settings in industry, local and federal government, and labor organizations. For example, one student worked on several activities at the University of Maryland Environmental Health Education Center and was ultimately employed there following her graduation. Other examples of potential practicum sites include the Maryland Department of the Environment (with E. Coe, RN, MPH), Center for Lead Safe Housing (with P. McLaine, RN, MPH) and Chesapeake Occupational Health Services (with R. Moreland, RN, PhD). The availability of preceptors has increased over recent years, in part due to the fact that over half of the graduates of this program have taken positions in the region.

#### Master of Science in Nursing / Master of Public Health (MSN/MPH)

We are fortunate to have an affiliation with a thriving and successful School of Nursing that, since its inception in 1984, has been quickly ascending to a leadership position in nursing education. The School has approximately 500 students in undergraduate, graduate, and post-doctoral programs. The School's second dean, Sue K. Donaldson, PhD, was appointed in 1994 and continues the school's tradition of an excellent relationship with the school's partners at the medical campus, i.e., the School of Hygiene and Public Health and the School of Medicine. A measure of the commitment of the university to the School of Nursing is the five-story, 92,800 ft<sup>2</sup>, building now under construction which will be the new and permanent home of the school. The growth of the School of Nursing includes directions that have produced exciting opportunities for the OHN Program. The first has been the development of the joint degree program between the schools.

The joint degree program in Nursing and Public Health combines the Master of Public Health and the one-year Master of Science in Nursing into an 18 month program of full-time study for nurses who seek to integrate advanced nursing practice with public health perspectives. Because approximately one-third of the credits are available to accommodate a specific area of emphasis, the requirements of the joint program easily blend with those of the Occupational Health Nursing Program. The joint program curriculum includes all requirements for the MPH and MSN degrees plus four courses specifically designed for the joint program: Public Health Theory and Practice, Public Health Leadership and

Management, and two practicum courses that complement those didactic courses. For OHN students, practicum activities related to occupational and environmental health are available. Table 7 lists the MSN and specific joint program requirements. Dr. Agnew has been instrumentally involved in developing the joint program and serves as the Chair of the Steering Committee. As the third cohort enters the program, it is growing in size and quality; GRE scores of applicants this year were outstanding. Three OHN students have opted for this program to date, and interest is clearly escalating among the applicants.

TABLE 7. Required Courses: Master of Science in Nursing and MSN/MPH Joint Program

NUMBER	COURSE TITLE	CREDITS *
MSN Core:		
NR100.500	Concepts and Theories in Nursing	3
NR100.513	Inferential Biostatistics**	2
NR100.503	Research Design Methodology	3
NR100.505	Nursing Informatics	1
NR100.533	Ethics of Health Care**	2
NR100.509	Scholarly Project	1
Joint Courses:		
NR500.601	Public Health Nursing Theory & Practice	3
NR500.605	Public Health Nursing Leadership & Management	4
NR500.602	PHN Theory & Practice Practicum	2
NR500.606	PHN Leadership & Management Practicum	4

\* Note: School of Nursing is on semester system, therefore these represent semester credits.

\*\* Courses at School of Hygiene may be substituted for these requirements.

### 3. Doctoral Program

The Research Training Program in Occupational Health Nursing was the first of its kind in the country and is designed to train occupational health nurses as researchers, administrators, educators, and policy-makers. The pre-doctoral training supported by this program leads to the degrees of Doctor of Philosophy (PhD), Doctor of Public Health (DrPH), or, less commonly selected, Doctor of Science (ScD).

The research component of the OHN Program is located primarily within the Division of Occupational Health, Department of Environmental Health Sciences, where students follow the course of study in the divisional doctoral program. Students from other departments who have strong occupational health research interests may also be eligible for the program provided ERC faculty have input into the student's training and guidance.

The research directions of the OHN doctoral program parallel those of the program faculty and also relate to the principal areas of research in the division which are discussed in the Occupational Medicine section, but can be summarized as: the validation of biomarkers of exposure, risk, and susceptibility; special populations at risk; and health services and outcomes research. The research focus of OHN faculty is particularly aimed at special populations at risk, notably workers who are aging, adolescent, disabled, or experiencing chronic diseases. We feel that issues that relate to the stage of a worker's life span are especially appropriate for nursing research.

Faculty research interests address several priority areas that were identified by NIOSH and its partners in the development of the National Occupational Research Agenda (NORA) in 1996. Examples include: asthma and COPD, musculoskeletal disorders of the upper extremity, fertility and pregnancy abnormalities, traumatic injuries, organization of work, and special populations at risk. In addition to overall divisional influences on the OHN research program, we have an outstanding relationship with the other ERC Programs (Industrial Hygiene and Injury Epidemiology) and frequently interact with those programs in research endeavors, thus providing rich experiences for doctoral students and excellent examples of interdisciplinary interaction.

Admission criteria are designed to recruit applicants with strong research interests as well as academic and leadership potential. Our goal is to recruit and admit highly qualified candidates at the rate of two per year. Although the number of inquiries and applicants to the doctoral program has increased, the average rate of admission has been one per year for four years. The rate of acceptance depends on financial support, the pool of qualified applicants and the availability of faculty advisors with appropriate interests. We strongly encourage doctoral students to enroll in full-time status for the fullest educational experience, exposure to non-credit activities, and ability to efficiently concentrate their research work. All students must spend at least one year in full-time status, but some have found it financially necessary to work while attending part-time. Fortunately, ERC funds have made full-time study a possibility for some. Recruitment of strong candidates continues to be a major thrust of our plan. The second goal is to increase student funding. One helpful action in this regard has been the departmental supplementation of doctoral student stipends, assisting students who otherwise would suffer financial hardships.

#### 4. Contributions to the Discipline

As the first program to prepare occupational health nurses with doctoral degrees, the Johns Hopkins ERC has produced many leaders in occupational health nursing education and research. Graduates of the doctoral program now direct and teach in other NIOSH supported programs, hold other university faculty appointments or are engaged in post-doctoral fellowships. These and other program graduates not only actively conduct research, but influence the direction and recognition of OHN research through publications, presentations, and leadership positions in national organizations. The Program focuses on quality with respect to the preparation of nurses who become leaders in the field and advance the knowledge base of occupational health nursing.

Program graduates are able to make major contributions to occupational health nursing and the knowledge base of this specialty area in part because they receive comprehensive training in all the activities related to research. For example, program requirements include the preparation of grant applications in the National Institutes of Health format and they frequently submit the application in an effort to obtain research funding. One current doctoral student actually revised her previously submitted grant and was successful in its funding as a NIOSH small grant. Students also are encouraged to present

their research findings at scientific meetings and to publish results in appropriate publications. These follow-through activities in research are the means by which the graduates, and thus the program, make significant contributions to the field.

#### 5. Program Support from Research Sources

ERC funds are critically important for the support of newly admitted students; this support has been used primarily for tuition and stipend. A limited amount has been provided as seed monies for student research expenses, such as local travel costs and supplies. Even small amounts of assistance help expedite the research phase of students' doctoral programs. For example, one doctoral student has received support for travel to Washington, D.C. to discuss her proposed research project with union representatives. These meetings made the difference in gaining cooperation and support for the study. Our plan is to continue to pursue sources of external funding for all aspects of the program, including grant submissions which include student researchers.

While the primary source of tuition and research expense support for OHN students has been ERC funds, some funds have been obtained for research support from private and government sources. A student who is studying acceptance of hepatitis B vaccine, Gwendolyn Hammer, submitted a successful proposal to Merck Corporation for partial support of her project and also received support from SmithKline, another manufacturer of the vaccine. In addition, as mentioned above, Ms. Hammer has received a small grant from NIOSH. The same student received resource support from the Service Employees International Union, including time and assistance of personnel of the local. Another student, Mr. Schneiderman, recently assisted Dr. Agnew in preparing a grant application to the Department of Defense.

Whenever possible, we encourage submission of grant applications by doctoral candidates or their close involvement in submissions to federal funding agencies such as NIOSH and various institutes of NIH. Even when grant applications are not successfully funded, there is merit to this process. Students learn about the peer review process of grant review and have an opportunity to experience it first hand. Although all students must develop their doctoral proposal in the NIH format, there are many more components to an actual grant submission. We have received feedback from program graduates that they are much better prepared to function in the competitive research world as a result of their familiarity with the NIH granting system.

With regard to funds available from the school, doctoral students who matriculated before 1994 and who are in the research phase of their program are eligible for a school scholarship of 85% of tuition costs for a maximum of five years. An OHN Scholarship Fund has also been developed and we are working with the development office of the school to enhance its level.

Faculty have successfully obtained research support from external sources. Dr. Agnew recently was awarded a SERCA grant from NIOSH which has provided partial support to her. She has also begun to work with the Johns Hopkins Center for VDT and Health Research which will support a portion of her salary. Drs. Agnew and Fitzgerald have a grant submission pending with the Department of Defense, and Dr. Fitzgerald has a grant application pending with the Agency for Health Care Policy and Research and is preparing a grant for the National Heart, Lung, and Blood Institute. As the degree of external research funding for faculty of the program increases, more funds are made available for student support. This is consistent with our objectives for the program.

## 6. Evaluation of Training Effectiveness

Information that assists in evaluation of OHN Program effectiveness has been obtained by monitoring the career experience of graduates. Since 1991, we have worked to build and update a data base of all graduates for the primary purpose of surveying their employment experiences and other means by which they are contributing to the field of occupational health. In 1991, we conducted a detailed survey, and have tracked graduates to the best of our ability since that time. In 1996 we have repeated a brief survey to validate locations and to assess involvement in occupational health issues. We estimate that approximately 80% of graduates are in jobs that utilize their background in occupational and environmental health. Of interest with regard to the contributions graduates make beyond their organizations of employment is the fact that almost 50% report that they have made presentations about occupational/environmental health issues to professional organizations or community groups and 58% have taught or served as preceptors for college level students. These results demonstrate the program effects that reach beyond the immediate scope of occupational health nursing employment.

Additionally, we have found that the employment experience of graduates indicates that graduates of this program are prepared for roles in a variety of settings where a nursing perspective was not previously incorporated. As a testament to the quality of graduates and the degree to which they are regarded in the occupational health community, we regularly receive inquiries from employers at regional and national levels who seek to employ program graduates.

## **D. Occupational Medicine Program**

### **1. Organization and Faculty**

The Occupational Medicine Residency (OMR) resides primarily in the Division of Occupational Health in the Department of Environmental Health Sciences in the School of Hygiene and Public Health. The Division has eight full-time faculty whose interests span a wide range of topics in occupational health, including clinical toxicology, assessment of lead exposure and dose, susceptibility factors for lead intoxication, occupational epidemiology, medical surveillance in occupational health, occupational pulmonary disease including occupational asthma, occupational risks of outdoor workers, Lyme disease in outdoor workers, occupational carcinogenesis, molecular dosimetry, occupational health nursing, occupational health psychology, neurobehavioral toxicology, repetitive motion disorders in the workplace, and outcomes research.

Several Divisional faculty are very active in residency training and are considered core OMR faculty. Dr. Brian Schwartz is Director of the Residency and Director of the Occupational Medicine program in the ERC. He assumed the position of Director of the Division of Occupational Health, the academic Division in the Department of Environmental Health Sciences in which the OMR is administratively located, on 1 September 1996. He is responsible for the administration of both the academic and practicum years of training as well as the recruitment and admission of students, monitoring of students' progress and liaison with external rotations. Dr. Schwartz is board certified in internal medicine and occupational medicine. His primary research interests are in the health effects of exposure to solvents and lead (inorganic and organic) and Lyme disease in outdoor workers, with a focus on the development of biomarkers of tick exposure and Lyme disease risk. Dr. Clifford Mitchell is Deputy Director of the residency, and is actively involved in the administration of the program, is a member of the Residency Selection Committee that interviews candidates and offers acceptances, and is an important contributor to the teaching and clinical programs. His research interests are in medical surveillance, cost-effectiveness analysis, occupational health policy, and repetitive motion-related disorders. Dr. Mitchell, a graduate of the program, joined the faculty in July 1992. He is board-certified in both internal medicine and occupational medicine. Dr. Mitchell also directs the clinical occupational medicine and plant walk-through and evaluation courses during the academic year. Another core faculty member is Dr. Virginia Weaver. Dr. Weaver is a graduate of the program who joined the faculty in August 1993. She is actively involved with the program as a member of the Resident Admissions Committee, and is also an important contributor to the teaching and clinical programs in the Division. She is board-certified in both internal medicine and occupational medicine. Her research interests are in the use of biomarkers in occupational epidemiology and medical surveillance. She has ongoing projects involving urinary biomarkers of environmental benzene exposure, and renal biomarkers in subjects with occupational and environmental lead exposure. She was recently the recipient of the first Ho-Ching Yang Memorial Faculty Fellowship at Johns Hopkins, a prestigious research award for faculty in the School.

Two other faculty are actively involved with the Residency Program as core faculty. These are Drs. Karen Bolla and Paul Strickland. Dr. Bolla, a Ph.D. neuropsychologist, is active in the teaching and seminar programs, and supervises residents in the neurobehavioral evaluation of workers after neurotoxin exposure as a practicum year elective rotation. Dr. Strickland was Acting Director of the Division of Occupational Health. He schedules and organizes several seminar series that are required for the residents and doctoral students and he has supervised several residents in research rotations and

numerous doctoral students in their thesis research. Several residents have spent a third year of residency training in Dr. Strickland's laboratory (e.g., Nathaniel Rothman, Virginia Weaver). He heads the Division's Genotoxicology Laboratory and his research interests are in DNA damage after UV and PAH exposure and molecular epidemiology of cancer.

Other members of the Division interact with the OMR, primarily through journal clubs, seminars, and course instruction. Dr. Jacqueline Agnew, Director of the Occupational Health Nursing Program and Director of the ERC, organizes a component of the seminar program. Dr. Sheila Fitzgerald is also in the Occupational Health Nursing Program. Her area of interest is return to work issues after acute illness and chronic disease impact on work performance. Dr. Jacqueline Corn teaches a popular course on the History of Occupational Health. Dr. Edward Bernacki, Director of Occupational Health and Safety at Johns Hopkins Hospital and University, jointly appointed in the Division, is a preceptor of a required industrial practicum rotation and an active participant in the teaching and seminar programs. Finally, Dr. John Parkerson, Associate Director of the Center for Occupational and Environmental Health (COEH) in the Division of Occupational Medicine in the Department of Medicine has served as a preceptor for several resident practicum rotations in the COEH and is active in the teaching programs. He is board-certified in occupational medicine.

The faculty in Table 8 are actively involved in the OMR. Except where otherwise noted, all have their primary appointments in the Division of Occupational Health. Included are core faculty, rotation preceptors, active teaching and seminar program participants, and research preceptors.

Table 8. Faculty of the Occupational Medicine Program

Name	Appointments	Area of Expertise
<b>Core Faculty</b>		
B. Schwartz, MD, MS	Director of OMR Associate Professor, Occupational Health, Medicine, Epidemiology	occupational epidemiology molecular epidemiology neurobehavioral toxicology lead intoxication & biomarkers occup. Lyme & vector-borne disease
C. Mitchell, MD, MPH, MS	Deputy Director of OMR Assistant Professor, Occupational Health, Medicine	occupational pulmonary disease cost-effectiveness of occupational health repetitive trauma OHS policy
V. Weaver, MD, MPH	Instructor, Occupational Health, Medicine OMR Selection Committee	medical surveillance lead-induced renal disease & HTN molecular epidemiology - benzene cumulative trauma disorders
K. Bolla, PhD	Associate Professor Neurology, Environmental Health Sciences	neurobehavioral toxicology neuropsychology CNS effects solvents, CNS effects lead multiple chemical sensitivity
P. Strickland, PhD	Associate Professor, Occupational Health	molecular epidemiology molecular dosimetry-PAH UV damaged DNA in skin epidemiol of PAH-associated cancer

<b>Other Selected Key Faculty (continued)</b>		
J. Agnew, PhD	Associate Professor, Occupational Health	repetitive trauma neurobehavioral toxicology occupational health nursing the aging worker
S. Fitzgerald, PhD	Assistant Professor, Occupational Health	return-to-work disability and impairment health promotion
W. Stewart, PhD	Associate Professor Department of Epidemiology Research preceptor Director Occup Epidemiology	occupational epidemiology neuroepidemiology molecular epidemiology interaction of chem expos & CNS aging
M. Tockman, MD, PhD	Associate Professor, Occupational Health	occupational lung disease early detection - lung CA molecular epidemiology & dosimetry
J. Patz, MD, MPH	Research Associate, Occupational Health and Molecular Microbiology & Immunology	environmental medicine health effects of global climate change environmental health policy
J. Parkerson, MD, MS	Instructor, Div of Occup Med, Dept of Medicine, Assoc Director, COEH; Elective Rotation Preceptor	musculoskeletal disorders & injuries independent medical exams provision of OHS services
E. Bernacki, MD, MPH	Associate Professor, Director, OHS, Johns Hopkins Hosp/Univ Required Rotation Preceptor	OHS management OHS administration OHS marketing
<b>Other Rotation Preceptors</b>		
S. Guarnieri, MD, MPH	Required Rotation Preceptor Director, OHS, Balt Gas & Electric	OHS management OHS administration
R. Duffy, MS	Required Rotation Preceptor Director, OHS, Intl Assoc Fire Fighters	health risks in fire fighters legislative process, union OHS programs
A. Alcarese, CIH	Required Rotation Preceptor Maryland Occup Safety & Health Commission	OHS regulations, site inspections industrial hygiene safety engineering
A. Presson, MD, MPH	Elective Rotation Preceptor OSHA	OHS regulations OHS legislation
J. Fortuna, MD	Elective Rotation Preceptor Director, OHS, General Motors Van Plant	plant OHS management workers' comp mgmnt repetitive trauma

In addition to the current breadth and depth of faculty indicated above, the Division of Occupational Health is currently engaged in searches for additional faculty. For example, we are currently recruiting faculty with laboratory skills to assist in molecular epidemiologic studies.

## 2. Occupational Medicine Residency

a. Academic Year - Masters Program

The didactic component of the OMR is particularly strong. Several of our courses have been revised; an integrated, three course occupational health and medicine core curriculum has been developed; and new developments in the field have been integrated into the teaching program. A list of required and recommended courses for the Occupational Medicine trainees is listed below:

Summer Quarter

221.637 Health Information Systems	2 credits
550.605 History of Public Health	1 credits
300.603 Social & Behavioral Aspects of Public Health	4 credits
140.607 Introduction to Computing	3 credits
140.601 Introduction to Biostatistics	5 credits

First Quarter

188.680 Fundamentals of Occupational Health (Director - Dr. Schwartz)	3 credits
187.610 Principles of Toxicology	4 credits
340.601 Principles of Epidemiology	5 credits
260.601 Biological Basis of Public Health	4 credits
182.631 Principles of Occupational Safety	2 credits

Second Quarter

180.601 Environmental Health	5 credits
182.625 Principles of Industrial Hygiene (Director - Dr. P. Lees)	4 credits
182.621 Introduction to Ergonomics (recommended)	3 credits
304.681 Public Health and the Law (recommended)	3 credits
182.633 Occup Safety and Healthy Law (recommended)	3 credits

Third Quarter

188.684 Clinical Occupational Medicine (Director - Dr. Mitchell; teaching also by Drs. Weaver and Schwartz)	4 credits
182.623 Occupational Safety and Health Management (Director - Dr. M. Corn)	3 credits

Fourth Quarter

188.681 Occupational Health (work-site inspection course) (Director - Dr. Mitchell)	5 credits
340.618 Occupational Epidemiology (recommended)	4 credits
305.615 Occupational Injury Prevention and Safety Practice (recommended)	2 credits

There are a wide variety of attractive electives, including: Occupational Health in Developing Countries; Basic Biostatistics - Inference; Public Health Practice; Foundations of Tropical Public Health; Survey of Radiation Physics; Occupational Hearing Loss and Noise Control; Epidemiology of Injuries; Fundamentals of Clinical Preventive Medicine; Airborne Particulates; Molecular Biology of Carcinogenesis; Health, Work & the Labor Movement; Toxicokinetics; Biochemical Aspects of

Pulmonary Function; Molecular Epidemiology and Biomarkers in Public Health (Director - Dr. Strickland); and Historical Perspective on Current Issues in Occupational Health.

OM Residents must also complete all M.P.H. requirements (courses in epidemiology, biostatistics, biological sciences, management sciences, history, and other courses). The epidemiology and biostatistics offerings in the School are particularly rich and deep, and residents are encouraged to complete as much of the five course epidemiology series and four course biostatistics series as possible, but a minimum of two courses in each.

The ERC faculty have met and revised the occupational health curriculum after a retreat in September 1995. The Fundamentals of Occupational Health course now includes participation of faculty from all ERC programs and introduces students from all programs to the field. During the second and third quarters, students complete second and third level courses in their respective program areas. In the fourth quarter, the Occupational Health Worksite Inspection course brings students altogether again for group-based evaluations of plants, requiring teams of students representing all program areas to work together on plant evaluations and class presentations. Finally, ERC students will now be required to take two credits of special studies credits in interdisciplinary activities, awarded in the quarter in which the student accrues the required number of points in these activities. Examples include attendance at a seminar of another group, presentation of a joint seminar with a student of another discipline, work in clinic, participation in an industrial hygiene survey or safety evaluation, or participation in interdisciplinary field trips.

The first year curriculum thus represents a very broad and deep educational experience, with an integrated curriculum in an order of courses that builds on prior course work and skills, leading into the practicum year, where these nascent skills can be applied to problems in actual work settings.

#### b. Practicum Year

The second year of the residency consists of four required two-month rotations and two two-month electives. The second year of the residency remains strong, with four core required rotations that continue to receive high praise from the residents. This phase of the residency begins in July of the second year, following completion of the M.P.H. requirements. The resident is expected to continue to attend the Occupational Medicine Seminar, Journal Club and Grand Rounds. Second-year residents are dispersed among many sites at any one time; because of this, residents come together at the School on Monday afternoons to discuss relevant issues and attend the Divisional seminars (i.e., Grand Rounds, Journal Club). The second year is designed to provide all residents with exposure to five important settings in occupational health: government, clinical, industrial plant, industrial corporate, and union. The required rotations include:

- 1) Johns Hopkins University/Hospital rotation (industrial rotation with clinical component) - **4th year of involvement with residency;**
- 2) Baltimore Gas & Electric Co., Baltimore (industrial rotation with clinical component) - **6th year;**
- 3) Maryland Occupational Safety and Health (MOSH; regulatory rotation) - **3rd year;**
- 4) International Association of Fire Fighters, safety and health office at the union's headquarters in Washington, DC (union rotation) - **8th year.**

Several established elective rotations are available for residents to choose from, or they can develop new rotations, with the input of the Residency Director, to meet individual needs. Established elective rotations include the Maryland Department of the Environment; the Environmental Protection Agency; the Army's Center for Health Promotion and Preventive Medicine; Exxon Biomedical Sciences; SmithKline Beecham Pharmaceuticals; Rohm and Haas Chemicals; Mobil Corporation; University of Maryland Occupational Health Project; General Motors Van Assembly Plant; the Center for Occupational Safety and Health; CMC Occupational Health; Washington Occupational Health Associates; the Environmental Protection Agency; clinical rotations in dermatology, pulmonary, orthopedics, rehabilitation medicine in Johns Hopkins Hospital; and the Occupational Safety and Health Administration. During 1995-96, electives included the Office of Science and Technology Policy in the White House, Washington Occupational Health Associates, Hanford Nuclear Reservation, the Office of Occupational Medicine in the Department of Energy in Germantown, MD, clinical orthopedics at JHH, rehabilitation medicine at JHH, sports medicine at JHH, the National Security Agency, Robbins Air Force Base occupational medicine, McCormick Spice Corporation, Exxon Corporation in Texas, and other exciting sites.

The required rotations have been developed for curricular breadth and to ensure the attainment of specific competencies. For example, experience in clinical occupational medicine and related clinical specialties is provided at BGE and JHH/JHU; medical surveillance, workers compensation, impairment, disability, and administrative aspects are provided at JHH/JHU and BGE; occupational health at plant and corporate sites in a large public utility are provided at BGE; the legal, regulatory, and administrative issues in occupational health are provided at MOSH; plant inspection skills, identification and control of hazards, and worker training and education are provided at MOSH; and occupational health from the perspective of a large international trade union, worker training and education, labor issues, biohazards, and communication with the public are provided by IAFF.

The MOSH and IAFF rotations deserve special comment. These are both examples of partnerships with Region III institutions to meet Region III service needs and residency training needs at the same time, while providing important financial support to the residency. The MOSH rotation, initiated in July 1993, has been favorably reviewed by the residents. The rotation offers residents the opportunity to participate in regular plant site visits, generally 1-2 per week, and represents the first time the OMR has gained access to MOSH as a training site. This is an example of a fruitful partnership between the OMR and a state regulatory agency that meets mutual needs. Residents have also had an impact on the development and implementation of policy, participated in worker training and education, and have testified before the state legislature on such issues as lead in construction and environmental tobacco smoke. Finally, during AY 1995-96, we instituted a training and continuing education program for MOSH industrial hygienists and inspectors. Each resident during the two-month rotation prepares a two-hour presentation on the medical aspects of an important occupational health or industrial hygiene problem. MOSH inspectors are required to attend these presentations, which have been very well received. Topics during the past year included carbon monoxide poisoning, sick building syndrome, health hazards in the semiconductor industry, and the health effects of solvents. Similarly, the IAFF rotation, now in its eighth year, serves the needs of this large international trade union in Region III.

The rotation at the Johns Hopkins Hospital/University was expanded in July 1993 to meet the ACGME requirements for industrial rotations. The rotation is now an employer-based, comprehensive, multidisciplinary rotation involving clinical evaluations, injury care and management, workers' compensation management, industrial hygiene field experience, biosafety, radiation safety, and ergonomics. This rotation has also been favorably reviewed by the residents.

Each resident is encouraged to participate in research during the academic and/or practicum years. Research projects lead to the acquisition of laboratory- or population-based research skills. This has resulted in multiple publications and abstract presentations at national meetings. The research component of the OMR is closely integrated with the doctoral training program in the Division, with the same curriculum, seminar series, and training requirements.

There is also an emphasis on excellence in clinical training and evaluation of OM patients. Four of the eight months of the required practicum year rotations involve active clinical evaluation of workers as patients. This demonstrates our commitment to providing our trainees a thorough experience in clinical OM. Numerous electives allow the resident to focus on specific clinical training needs (e.g., medical specialty clinics in orthopedics, rehabilitation medicine, dermatology, training in independent medical examinations) during the four month elective period.

Several administrative changes that were made during 1994-95 have been continued. The recruitment and marketing brochure continues to be very useful; the comprehensive Resident's Manual is updated yearly and is very useful to the residents; and the orientation program for incoming residents continues to provide new residents with an industrial plant visit within the first week of the residency. The orientation has been highly reviewed by the residents.

During the practicum year, there is also ample opportunity for interdisciplinary interaction. For example, OM residents on rotation at JHH/JHU work with industrial hygiene students and John Schaeffer, the industrial hygienist in the Environmental Safety office, on evaluation of workplace hazards, and residents on rotation at IAFF work with industrial hygiene and nursing students on projects in worker training and education in fire fighters and response to locals with questions about the hazards of fire fighting.

### 3. Research Training

The major objectives of the Research Program in Occupational Medicine are twofold. They include: (1) the support of post-doctoral research fellows (including occupational medicine residents) and new faculty initiating research careers; and (2) the support and training of doctoral students. The research training program is well integrated into the teaching, training, and research programs of the Division of Occupational Health and the Occupational Medicine Residency. Residents and doctoral students complete the same curriculum, attend the same seminars, and have the opportunity, if desired, for the same field-based, laboratory-based, and clinical experiences. The OMR and research training programs are thus completely integrated.

The principal areas of research that are currently undertaken in the Division of Occupational Health include the following: occupational neurotoxicology, repetitive motion disorders, occupational epidemiology, Lyme disease in outdoor workers, molecular epidemiology and dosimetry, occupational pulmonary disease, occupational cancer and genotoxicity, the health effects of lead and solvents on

occupationally-exposed workers, and issues surrounding appropriate medical surveillance and its cost-effectiveness (for occupational health nursing faculty research, see OHN section). The overall research program is coordinated by Drs. Strickland and Tockman. These research areas are consistent with priority areas of the National Occupational Research Agenda, published by NIOSH in April 1996, as outlined in Table 9.

Table 9. Faculty and research areas

NORA category	Faculty member	Ongoing research projects
<b>Disease and Injury</b>		
Asthma and COPD	Dr. Mitchell	Nickel-induced nonmalignant lung disease
Infectious diseases	Dr. Schwartz	Lyme disease in outdoor workers Other vector-borne diseases in outdoor and agricultural workers
Musculoskeletal disorder of the upper extremities	Dr. Weaver	Evaluation of the benefits of physical therapy for cumulative trauma disorders in automotive industry (Ford Motor Co.)
<b>Work Environment and Workforce</b>		
Indoor environment	Dr. Mitchell	Sensitivity to inhaled volatile organic compounds
Special populations at risk	Dr. Schwartz Dr. Schwartz Dr. Strickland	Genetic risk factors for lead intoxication Infectious diseases in outdoor workers Genetic risk factors for carcinogenesis
<b>Research Tools and Approaches</b>		
Cancer research methods	Dr. Strickland	UV-induced DNA damage PAH-associated cancers Molecular epidemiology
Exposure assessment methods	Dr. Schwartz Dr. Weaver Dr. Strickland	Lead biomarkers: DMSA-chelatable lead, bone lead Biomarkers of benzene exposure Biomarkers of PAH exposure
Intervention effectiveness research	Dr. Mitchell	Cost-effectiveness of drug testing Cost-effectiveness of repetitive motion disorders interventions
Surveillance research methods	Dr. Weaver	Medical surveillance in former DOE workers (proposal pending)

The Division of Occupational Health thus has an active research program in many of the NORA highlighted areas. However, our greatest strengths are in the areas of the development and validation of biomarkers of exposure, risk, and susceptibility; special populations at risk; and health services and outcomes research.

The Doctoral Program Training Committee is administered by members of the faculty of the Division of Occupational Health who are involved in the supervision of graduate students. The graduate program brings together students from nursing, medicine, and other disciplines. Doctoral student advisors from the adjunct faculty and other departments participate in the program enhancing its interdisciplinary character. Research training at the postdoctoral level (i.e., for OM residents and further research training after the Ph.D. degree) builds upon research skills in epidemiology, biostatistics, and laboratory sciences acquired during the academic year and is enhanced by a series of Research in

Progress seminars where in faculty review key issues of clinical or epidemiologic research which are of import in study design, data collection and analysis. Further, Journal Club teaches skills of critical study review which are also essential for residents undertaking research. Residents identify topics of interest or these are suggested to them by faculty and a faculty preceptor is identified for each resident. The preceptor guides the resident through the longitudinal experience. Drs. Agnew, Tockman, Strickland, Schwartz and Fitzgerald are all involved in these activities.

#### 4. Contributions to the Discipline

During the grant period, the OMR developed and strengthened ties to the Maryland chapter of the American College of Occupational and Environmental Medicine. Dr. Mitchell is a member of the Board of Directors and the Director of Continuing Medical Education Curriculum for Maryland ACOEM; this has lead to expanded Maryland ACOEM continuing education offerings, increased attendance at Maryland ACOEM meetings, and an increasing impact on primary care disciplines at these meetings. For example, at a recent continuing education offering on workers' compensation, the majority of attendees were not occupational health specialists, with primary care practitioners and lawyers prominent among the attendees.

The OMR has also increased its union and worker training experiences. For example, OMR faculty and residents have participated at the George Meany Center for Labor Studies in health and safety training and respirator physicals for union workers, and Dr. Mitchell has provided worker training and education to the machinists union twice annually the past several years.

The OMR has continued its efforts to recruit minority residents. We developed brochures that were sent to internal medicine, family medicine, and emergency medicine residencies of institutions with traditionally strong minority representation in Region III and brochures were sent to African American universities.

#### 5. Program Support

The OMR at Johns Hopkins has received a total of 16 person-years of resident funding from ACOEM's Occupational Physicians Scholarship Fund (OPSF) in the past 6 years. The OPSF makes awards to individual residents in a national application process, who are then free to choose any OM residency in the country. This represents approximately 17% of all OPSF funding during that time, despite our program having only approximately 5.6% of total OM residents in the United States. This attests to both the high quality of our residents as well as the attractiveness of the program in recruiting the best residents in the country. Dr. Schwartz is also a member of the OPSF Campaign Steering Committee trying to raise additional funds to sustain OPSF for an additional five years.

Additional evidence of the success of the program is in leveraging NIOSH support to obtain additional training funds from Region III institutions. NIOSH funds currently cover only 30% of trainee costs. Contracts with second year practicum sites (IAFF, BGE, JHH/JHU, MOSH, and other sites) currently provide more financial support than the ERC Occupational Medicine budget. However, the ERC funds are critically important to enable us to leverage these other sources of external support. Without the ERC funds, our ability to train OM residents may be threatened to such a degree that this may force discontinuation of OM residency training at this institution.

Support for the research mission of the Division is derived from several sources, including peer-reviewed grants, contracts and general funds of the Johns Hopkins University. The level of support from external sources has been on the increase in the last several years and the past year saw the funding of several new contracts and grants. In addition to general University funds support of salaries, the faculty has attracted research support from other sources including NIOSH, NIEHS, NIAID, NIAMSD, NCI, NIA, NHLBI, EPA, Los Alamos National Laboratory, the American Cancer Society, the Nickel Producers Environmental Research Association, Abbott Corporation, Mobil Corporation, E.I. DuPont de Nemours Corporation, General Electric Corporation, American Maritime Association, Seafarers International Union, the Department of the Army, SCM Chemicals, and Baltimore City Occupational Safety and Health Department.

## 6. Evaluation of Training Effectiveness

### a. Demand and job opportunities for graduates

The positions of the Program's graduates attest to the Residency's effectiveness. Residency graduates continue to be in high demand and to obtain employment with relative ease. The Residency is clearly meeting regional needs as approximately 50% of graduates from 1992-96 accepted employment positions in Region III. Taking a longer view, Region III has over 30 Program graduates from the period 1981-1996 currently working in the Region. The Residency's graduates have attained positions of leadership in occupational health and occupational medicine in the Region and throughout the country. These positions are summarized in Table 10. The Program's graduates thus continue to have a large impact on OM training and practice in the Region and around the country.

Table 10. Employment experience of OM program graduates.

Employment Sector	Examples of OM graduates employed
Corporate medical directors, assistant directors, plant physicians, and corporate physicians	Robert Bonner at Philadelphia Electric and Power Company, James Palmier at SmithKline Clinical Laboratories, Dyann Waugh at the U.S. Postal Service, Richard Dockins with the Exxon Corporation, Benjamin Withers at Xerox Corporation, Donald Molenaar at Unocal Corporation, Janet Fujikawa at Loral Federal Systems, Deborah Ratliff at Intracorp, Ronald Joines and Anne Kuhnen at SmithKline Beecham Pharmaceuticals, Sheila Rhodes at Baltimore Gas and Electric Company, Andrew Vaughn at Eastman-Kodak, and Vianka Austin-Dailey at IBM Corporation
Academic occupational medicine faculty	Brian Schwartz, Clifford Mitchell, Jonathan Patz, and Virginia Weaver at Johns Hopkins University, John Balbus-Kornfeld at George Washington University, Gary Rischitelli at Oregon Health Sciences Univ, Brian Forrester at the Univ of Alabama, Anthony Suruda at the University of Utah, Rebecca Bascom at the Univ of Maryland, Joseph Falco at SUNY Stonybrook, William Beckett at Yale Univ, Eric Schaub at the Medical College of Ohio, and Tee Guidotti at the Univ of Alberta
Government service	Melissa McDiarmid at OSHA, Jocelyn Apollon at the National Security Agency, Ronald Stout at Kelly Air Force Base, Marianne Cloeren at the Veterans Administration Medical Center, Tara O'Toole at the Department of Energy, Hugh McKinnon at EPA, Malinda Midzenski at the Baltimore County Health Department, Curtis Wright at FDA, and Nathaniel Rothman at the National Cancer Institute
Occupational medicine clinical services	Scott Edwards at Saint Josephs Medical Center, Patrick Bray at St. Vincents Charity Hosp, Edward Jones at Saint Lukes Hosp, Jeffrey Larson at North Arundel Hosp

b. American Board of Preventive Medicine certifying examination performance

In 1996, for the first time, the American Board of Preventive Medicine provided residency directors with board scores of their graduates who completed the examination in the two years 1994 and 1995. Of the eleven persons who completed the two year OMR at Johns Hopkins and took the test during these two years, all passed the examination. The mean board scores of JHU OMR graduates were significantly higher than the national means for all examinees and OM residency trained examinees. These test scores attest to the high quality of the program and its graduates.

<u>Group</u>	<u>Core Area</u>	<u>OM Specialty Area</u>
JHU OMR graduates	595	565
National OM residency trained	525	510
All OM test takers	435	440

c. New methods to assess effectiveness

During the next grant period, the OMR will develop new methods to assess competencies for occupational medicine residents. During 1996, the Health Resources and Services Administration preventive medicine competencies were evaluated by resident self-assessment. One important goal of the current grant period was to develop improved methods for evaluating competencies, including at a distance for participants in distance education. A second goal of the current grant period was the development of a database of OMR graduates that will be used to track their contributions in the field, according to a standardized format including impact in the region and nationally, impact on specialists and non-specialists, impact on workers, and impact on the practice of occupational medicine in primary care providers.

The OMR recently raised the issue of long-distance practicum years with the Graduate Medical Education Committee in the School and plans to take a leading effort in the development of such practicum experiences. One key element of such practicums is the importance of the evaluation of competencies, which will be one area of emphasis for the new grant period.

## **E. Occupational Injury Prevention and Safety Sciences**

### **1. Organization and Faculty**

The Injury Prevention/Safety Sciences Program first received funding in 1990. Located in the Department of Health Policy and Management, it is the only one of the ERC components that administratively resides outside of the Department of Environmental Health Sciences. The program has core faculty supported in part by the ERC and a much larger pool of faculty who are a part of the extensive resources available to all students here at the school. These provide a diverse breadth of experience in teaching and research. Table 11 describes faculty and their areas of expertise.

**Program Director:** Gordon S. Smith, M.D., M.P.H. Dr. Smith is Associate Professor of Health Policy and Management. He also has joint appointments in the Departments of Epidemiology at The Johns Hopkins School of Hygiene and Public Health, and Emergency Medicine at the Johns Hopkins School of Medicine. Dr. Smith directs the training program and oversees all aspects of its administration. He continues to develop new training opportunities for the program, coordinates the courses "Injury Epidemiology" and "Occupational Injury Prevention/Safety Practice", and the "Seminars in Occupational Injury Prevention and Safety."

**Co-Director:** Susan P. Baker, M.P.H. Professor Baker serves as Co-Director of the training program, chairs the admissions committee, supervises research projects, and participates actively in the teaching program as part of her involvement in the training grant. In addition, she teaches the main introductory course, "Issues in Injury Control", directs the course "Aviation Safety," and assists in teaching "Injury Epidemiology". She actively co-directs the research training program, including supervising students on their doctoral research. An important part of Professor Baker's work is the mentoring of all students in the program, not only those she supervises personally.

James L. Weeks, Sc.D., C.I.H. Dr. Weeks coordinates the course "Occupational Injury Prevention and Safety Practice" with Dr. Smith. He is also actively involved in the development of research projects on both mining and construction injuries with students. He is an invaluable resource to students on the practical issues of conducting research in the workplace, and is an adjunct member of the faculty. While he is paid as a consultant because of reimbursement regulations, he serves as an active member of the faculty of the program.

Joanna Sznajder, Ph.D., is a Lecturer in the Division of Environmental Health and Engineering. She is full time on the faculty and teaches the course on ergonomics. She received her Ph.D. degree in Ergonomics and Natural Sciences at the Department of Ergonomics, Institute of Maritime and Tropical Medicine in Gdynia, Poland. Her previous research has been in the maritime industry where she conducted research and provided consultation on safety and ergonomic issues among marine industry employees.

Morton Corn, Ph.D., is Professor and Director, Division of Environmental Health Engineering, at The Johns Hopkins School of Hygiene and Public Health. He is also a Certified Safety Professional. Dr. Corn has been closely involved in the development of this program, particularly in strengthening the safety component of the curriculum. As a Certified Safety Professional, he teaches the two safety courses and guides student research.

Jeffrey V. Johnson, Ph.D., is an Associate Professor of Social and Behavioral Sciences and of Occupational health at the Johns Hopkins School of Hygiene and Public Health and is jointly appointed as an Associate Professor of Medicine at the Johns Hopkins School of Medicine and of Sociology in the School of Arts and Sciences. The addition of Dr. Johnson to our Occupational Injury Training program provides an important focus on psychosocial factors and injury risk which is an important new addition to the program. He is supported by the School with additional general funds to develop teaching opportunities in psychosocial factors and health and due to budget limitations is not supported by the ERC.

Miriam Alexander, M.D., M.P.H., is Director of the Office of Professional Education and Programs based in the Dean's Office, and also is the new head of the Preventive Residency Program. She brings several important skills to our training program. Dr. Alexander's background in occupational medicine and interest in collaborating in injury studies makes her an ideal person to supervise, jointly with Dr. Smith, the research rotation in occupational injuries proposed for preventive medicine residencies and to provide advice and mentoring to other students in our program. She also brings an important clinical perspective to the program. She is also director of the School's Professional Education and Programs Office.

Walter Stewart, Ph.D., is an Associate Professor of Epidemiology at The Johns Hopkins School of Hygiene and Public Health, in the Occupational and Environmental Epidemiology program. Dr. Stewart teaches Health Risk Assessment, and Occupational Epidemiology, a methods course on the conduct of various types of occupational studies and analysis and interpretation of data. Dr. Stewart regularly provides advice and consultation to our program in the development of new methodologies for occupational injury research and various student research projects. Because of budgetary constraints, we have been unable to support him financially from ERC funds, but have worked closely with him on externally funded research projects.

Byron S. Tepper, Ph.D., is an Adjunct Associate Professor, Division of Environmental Health Engineering, Department of Environmental Health Sciences. Since 1976 he has been Director of the Office of Safety and Environmental Health for the Johns Hopkins Institutions (The Johns Hopkins Hospital and all divisions of The Johns Hopkins University). He is a Certified Safety Professional and a Certified Hazard Control Manager. He recently retired, but still teaches the course, "Health and Safety in the Research Laboratory" and is available to advise students.

Diane Fleming, Ph.D., is an Associate member of the Division of Environmental Health Engineering, Johns Hopkins School of Hygiene and Public Health, where she and Dr. Byron Tepper teach the course "Health and Safety in the Research Laboratory." Dr. Fleming is a biohazards and safety professional. She was formerly a member of the University Safety Office at Johns Hopkins and is now employed at the Frederick Cancer Research Center. Dr. Fleming assists in the development of the safety training component of our program.

Table 11. Primary Areas of Competence for Faculty

Name	Rank Title	Discipline
Gordon S. Smith	M.D., M.P.H., Associate Professor	Injury Epidemiology
Susan P. Baker	M.P.H., Professor	Injury Prevention/Epidemiology
James L. Weeks	Sc.D., C.I.H., Associate Professor	Occupational Health and Safety
Joanna Sznajder	Ph.D., Instructor	Ergonomics
Morton Corn	Ph.D., Professor	Safety/Industrial Hygiene
Miriam Alexander	M.D, M.P.H., Assistant Professor	Occupational/Preventive Medicine
Jeffrey Johnson	PhD., Associate Professor	Psychosocial work environment
Walter Stewart	Ph.D., Associate Professor	Occupational Epidemiology
Diane Fleming	Ph.D., Associate Professor	Safety, Biohazards
Byron Tepper	Ph.D. Associate Professor	Safety

## 2. Academic Program

The Occupational Injury Epidemiology and Prevention Training program has been developed to meet the national (and international) need for highly trained professionals in the prevention of injuries in the occupational setting. We are preparing professionals to assume leadership roles in a very new field; they will work in industry, government and academia. The most urgent need is for highly trained individuals at the doctoral level who can become program leaders to develop occupational injury prevention programs. We continue to concentrate on the development of a strong doctoral program (Ph.D., Sc.D. & Dr.P.H.), but also include training at the masters level (M.P.H. & M.S.).

Our innovative training program in occupational injury epidemiology and prevention builds on the strengths of the existing ERC core programs and the Injury Center. Although significant strides have been made with regard to the training of injury prevention professionals, there is a lack of training programs specifically addressing the unique problems and needs associated with occupational injuries. Most standards, regulations, and educational and other training programs continue to emphasize injuries in the manufacturing industry, where only 10% of all work-related deaths occur.

The educational objectives of our program are:

- a. Knowledge acquisition in the relevant areas of injury epidemiology and prevention, safety, biomedical, engineering, quantitative and social sciences in order to understand:
  - the causes, mechanisms, and population distribution of injuries related to workplace exposures and conditions.
  - the environmental, behavioral, and industrial processes that produce potentially hazardous agents and conditions that result in injuries.
  - the hazards of non-traditional workplaces such as agriculture and taxi driving.
  - the health effects, dose-response relationships, hazard and risk analyses, and markers of exposure and response to injury risks.

- the legal basis and the principal legislative acts and regulatory requirements that define and govern responsibilities for the control of hazards, and the actions and remedies available to individuals and groups to assure protection from such hazards, so that the appropriate research issues on which to base legislation can be defined.
  - the economics of competitive industrial production, the costs of medical care benefits and preventive measures, and the forces that operate through economic considerations to determine choices and priorities for implementing injury interventions, and how to conduct research under such constraints.
  - the social and individual values and behavioral factors that influence the setting of priorities and initiation of action on occupational injury prevention issues.
  - the design of workplace environments and an understanding of motivations and behavior patterns of individuals and employers with regard to injury risk.
- b. Skill development for integration and application of knowledge to occupational injuries through the "apprenticeship model" of research training by working with appropriately trained faculty. The program seeks to develop the following skills:
- critical evaluation of research data and the recognition of deficiencies in the scientific literature.
  - ability to recognize, define, develop hypotheses about, gather and analyze data for, draw meaningful conclusions regarding, and give recommendations for action on existing or anticipated occupational injury problems.
  - risk analysis, assessment, management, reduction, and hazard evaluation for occupational injuries.
  - oral and written communications about injury, especially occupational injury matters.
  - policy development and analysis and effective input to decision-making in government, industry, and the community.

The educational objectives are achieved through course work, field experiences, and research integrated with seminars, special studies, conferences, and written reports. The core curriculum is designed to provide a broad background in the range of disciplines relevant to the research and prevention of occupational injuries. These include injury prevention, safety sciences, environmental and occupational medicine, environmental engineering, biostatistics, epidemiology, economics, law, public health, and the management sciences. The exposure to the different points of view of the represented scientific disciplines is considered an important attribute of the program.

Because of funding constraints, the priority for funding in our program has been given to doctoral students, although masters students already here at the school are encouraged to participate in our program and resources are made available to encourage participation in research projects with faculty. Masters students are presently either supported by other programs or support themselves, although we will offer some support to attract bright promising professionals to the field. Many of our doctoral students have come through the MPH program.

Our course content reflects the strengths of the programs we have developed in injury epidemiology and prevention and the other safety sciences. Although this special component program is not technically a safety program, we have taken the recommendations of the NIOSH ERC Guidelines for Graduate Programs in Occupational Safety into consideration and as per their guidelines, have divided our courses into those "highly recommended" and an additional number of "recommended" courses. The highly recommended courses for the academic training portion of the doctoral program consist of a core of 25 courses, of which 12 are in either occupational injury or general principles of injury epidemiology

and prevention (in addition to five special studies courses, field placement, or thesis research). An additional two courses in injury prevention and a variety of other courses are also recommended. The courses by subject area are given Table 12.

It is highly recommended that doctoral students take the courses listed although programs are tailored to individual student needs, depending on their previous experience and future career goals. The courses in bold represent the essential required core courses. Doctoral students generally take two years of academic courses while most masters students take one.

The Masters program cannot include all the highly recommended courses because of the limited time the students are here. However, the courses highly recommended for masters students consist of those courses marked with (\*). These courses are in addition to the core required Masters of Public Health courses in biostatistics, computing, epidemiology, health information systems, environmental sciences, management, history of public health and social and behavioral sciences.

Table 12: Curriculum for the Program in Occupational Injury Epidemiology and Prevention

		<u>Credit Units</u>
A.	<u>Highly Recommended</u> (courses in bold are the required minimum)	
I.	<u>Occupational Injury Epidemiology and Prevention</u>	
	<b>305.615 * Occupational Injury Prevention and Safety Practice</b>	<b>2 units</b>
	<b>301.840 Research Seminars in Occupational Injury Prevention</b>	<b>1 unit</b>
	- Occupational Injury Research Methods (planned for future development)	3 units
	305.618 Aviation Safety (3rd Qtr.)	3 units
	<b>182.623 Occupational Safety and Health Management (3rd Qtr)</b>	<b>3 units</b>
	182.630 Safety and Health in the Research Lab (2nd & Summer Qtr)	2 units
	<b>182.631 * Principles of Occupational Safety (1st Qtr)</b>	<b>2 units</b>
	182.633 Occupational Safety and Health Law (2nd Qtr)	3 units
	<b>188.681 * Occupational Health (includes injury prevention safety) (4th Qtr)</b>	<b>6 units</b>
	<b>182.621 * Introduction to Ergonomics (2nd Qtr)</b>	<b>4 units</b>
	301.840 Special Studies and Research Health and Public Policy	2 or more units
	<b>301.810 Field Placement - Public Health</b>	<b>1 or more units</b>
	182.810 Field Placement - Environmental Health Engineering	1 or more units
	301.820 Thesis Research - Public Health	1 or more units
	182.820 Thesis Research - Environmental Health Engineering	1 or more units
ii.	<u>Injury Prevention</u>	
	<b>305.610 * Issues in Injury Control (1st Qtr)</b>	<b>2 units</b>
	<b>305.612 * Epidemiology of Injuries (3rd Qtr)</b>	<b>3 units</b>
	<b>305.613 Design and Evaluation of Injury Interventions (4th Qtr)</b>	<b>2 units</b>
iii.	<u>Industrial Hygiene/Occupational Health</u>	
	182.625 Principles of Industrial Hygiene (2nd Qtr)	2 units
	<b>182.629 * Historical Analysis of Occupational Health Policy (2nd Qtr)</b>	<b>2 units</b>
	<b>188.680 * Fundamentals of Occupational Health (1st Qtr)</b>	<b>3 units</b>
iv.	<u>Epidemiology</u>	
	<b>340.601 * Principles of Epidemiology (1st Qtr)</b>	<b>5 units</b>
	<b>340.602 Epidemiologic Methods: Intermediate Epidemiology (2nd Qtr)</b>	<b>6 units</b>
	<b>340.603 Cohort Studies: Design Analysis &amp; Applications (3rd Qtr)</b>	<b>4 units</b>
	<b>340.618 Occupational Epidemiology (4th Qtr)</b>	<b>4 units</b>

v.	<u>Biostatistics</u>		
	140.601 *	<b>Introduction to Biostatistics (1st and summer Qtrs)</b>	<b>5 units</b>
	140.602	<b>Basic Biostatistics - Inference (1st and 2nd Qtrs)</b>	<b>4 units</b>
	140.603	<b>Basic Biostatistics - Statistical Modeling (3rd Qtr)</b>	<b>4 units</b>
vi.	<u>Health Policy and Management</u>		
	300.600 *	<b>Introduction to Health Policy and Management (1st Qtr)</b>	<b>4 units</b>
B.	<u>Other Recommended Courses</u>		
	180.627	Hospital Safety: Occupational and Environmental Health Perspectives (4th Qtr)	4 units
	302.686	Psychosocial Work Environment and Health (4th Qtr)	3 units
	340.717	Health Survey Research Methods (1st Qtr)	6 units
	340.604	Design and Applications of Case-Control Studies (4nd Qtr)	5 units
	340.715	Problems in the Design of Epidemiologic Studies (4th Qtr)	6 units
	309.630	Emergency Medical Services and Systems (4th Qtr)	3 units
	301.627	Understanding and Preventing Violence (2nd Qtr)	3 units
	140.604	Basic Biostatistics - Observational Studies	3 units
	140.630	Introduction to Statistical Packages (2nd and 4th Qtrs)	4 units
	-	Biomechanical epidemiology - a new approach to injury (new)	2 units

\* Courses Recommended for Masters Programs

### 3. Research Program

The overall goal of the research program is to provide professionals with the ability to integrate the various skills in areas necessary for interdisciplinary research. These are: injury epidemiology and prevention, other safety sciences, epidemiology methods, biostatistics, biomedical sciences, behavioral sciences, legal, economic and social and ergonomic issues, and engineering technologies. Central to the development of these skills is the access to appropriate research databases and field sites for quality research. The provision of adequate resources for preliminary studies is also essential to enable students and faculty to compete for outside funding for larger studies. This "seed" funding provides important leverage for outside funding. All students in the research training program also take the academic training program.

A major focus of teaching activities in most of the Johns Hopkins programs is research training and experience. Traditionally, students have collaborated with faculty on ongoing research activities or initiated their own research under faculty guidance. The research training program on occupational injury epidemiology and prevention continues in this tradition, providing a variety of opportunities for students to acquire both practical skills in injury prevention and valuable research training experience. Several of the courses require students to develop small research projects.

All program trainees are required to directly participate in one or more projects or research efforts as part of their training. This training will take the form of (i) work with faculty on existing projects, (ii) development of students' own projects culminating in dissertation research, (iii) work and research experience as part of collaborative arrangements with outside groups. Students will be encouraged to be involved in some or all of the many opportunities for research and practical training. Projects will depend on the interest of students and suitable available research topics.

a. Field Study or Research Placement: The development of the numerous opportunities for funded research make the requirement of a research experience a possibility for all our training programs, even for masters students. We have been successful in that students have been working on a variety of projects including alcohol and occupational injuries, injury surveillance, our study of injuries to Chrysler workers, and collaborative projects with the Division of Safety Research in Morgantown.

b. Dissertation Research: To satisfy program requirements, the dissertation topic must be related to occupational injury epidemiology and prevention, must be in the area of concentration of the student, and must focus on a contemporary issue in occupational injuries. The dissertation may incorporate research techniques from several disciplines, and indeed this is strongly encouraged as appropriate to the program. Determination of the adequacy of preparation is a joint responsibility of the student, the advisor, and the dissertation committee. A dissertation committee of at least 4 members, chaired by the student's advisor, guides the student's progress. At least one member of the committee shall be a member of the program faculty from outside the student's primary department. The student will otherwise satisfy all the usual School requirements for the doctoral degrees.

c. Research Training for Preventive Medicine Residents: We plan to develop a three-month rotation for a preventive medicine resident to undertake research training. Preventive medicine residents are often involved in occupational health programs in addition to their work in state or county health departments or in academic medical positions. The ability to carry the occupational research training beyond the normal occupational training programs will greatly expand the scope and influence of our program. A resident would work on one of the approved research rotations under the supervision of Drs. Alexander and Smith. This unique program represents an opportunity to expand the research training to a group of individuals who will be in a position to conduct occupational research once they graduate and influence occupation health practice. The support services of this research program would be made available to preventive medicine residents for the research requirement of their residency program. There has also been a strong history of interest among occupational medicine residents in occupational injury research, with a number of research papers on the topic having been published by them in collaboration with our faculty.

d. Postdoctoral Training: We also hope to create in future years the provision for at least one postdoctoral training position to provide professionals having doctoral training in other fields (such as epidemiology) with the opportunity for research training in occupational injury epidemiology and prevention projects. This experience will help meet the urgent need for doctorally trained researchers in occupational injury epidemiology and prevention. The funding for this could come in part from some predoctoral stipend funds and/or outside support from other agencies.

During past years two post-doctoral students have worked on separately funded projects at DuPont, but no funded positions are currently available. We have also had support from the Snively foundation for engineers to come and work as a post-doc fellow with Professor Baker. This program has been very successful. One fellow, Dr. Flora Winston used this opportunity to also develop a new course, "Biomechanical epidemiology - a new approach to injury." The course was very successful and it is proposed to continue to offer this as part of the program.

Our school has also recently been awarded as one of two sites for post doctoral training in occupational health psychology. Funded jointly by the American Psychological Association and NIOSH, this program is directed by Dr. Jeffrey Johnson with Drs. Smith and Agnew as members of the program

faculty. Occupational Injury Epidemiology and Prevention is one of the required rotations for the post-doctorate fellows under the direction of Dr. Smith. This year there were over 25 applications for the single position.

e. Military Injuries Research and Training Program: Over the past few years an increasing number of military preventive medicine and aerospace residents have been coming to our school for their academic training (MPH). During this time most of the students take one or more of the courses in our injury program, with many taking the full series. A number have also worked with our faculty on research projects especially in the area of aviation safety. We have been recently awarded a grant to study injuries in the military, with an emphasis on the special hazards to women in the armed services. The study involves collaborating with colleagues in each of the three services. It is planned to further develop this area of research and training, especially the opportunities for student involvement and training as part of the new training initiative. At present, several students are working on military injury projects.

f. Development of Research Databases: The development of appropriate databases and opportunities for student research are central to our research training program. We are further developing three main databases that have been used for other studies and are capable of supporting occupational injury research.

(1). Maryland Medical Examiner Data: While vital statistics data are valuable for identifying problems and defining priorities, they provide little specific data that can be used to develop prevention programs or to understand the problem in sufficient detail. The medical examiner (ME) records are the single most complete source of information on fatal injuries in many locales. They contain information on how the injury occurred, such as photographs and blood alcohol and drug test results. We are developing Maryland as a model state for the ongoing surveillance of fatal occupational injuries and plan to collaborate with OSHA's efforts to improve reporting for occupational injury fatalities. In addition, the system will form the basis for more in-depth studies such as case-control studies of particular occupational injuries. We are working with Maryland OSHA regarding linking with their data for construction fatalities (a student project) and plan to expand this for all injuries. Thus, the ME database can provide exciting opportunities for future student research on fatal occupational injuries.

(2). Baltimore City Worker's Clinic: The Injury Prevention Center has worked closely with the City of Baltimore's Office of Occupational Medicine and Safety and is familiar with the large occupational group for which the office has responsibility. The City of Baltimore employs about 39,000 persons, or 10% of employed Baltimore residents. With certain exceptions, city employees who sustain occupational injury are treated at a single clinic operated by the Office of Occupational Medicine and Safety, which maintains a computerized risk information management system that is updated to include all new injuries incurred and new medical costs or periods of disability resulting from old injuries. Evidence of the Office of Occupational Medicine and Safety's willingness to participate in injury control research has been demonstrated by its enthusiastic collaboration with the investigators in five projects, to date. These are: (1) evaluation of low back injury claims, (2) a case-control study of occupational hand injury, (3) the epidemiology of motor vehicle related injuries occurring to City employees, (4) a case-control study of injuries to firefighters, and (5) an ongoing case-control study of back injuries. All projects have either been doctoral student projects or have had students work on the projects.

(3). Automobile Manufacturing Injuries Database: As part of a collaborative research project with The United Automobile Workers/Chrysler Health and Safety Committee we have been working on injuries in their various manufacturing facilities. To date two doctoral students are working on projects using this data and we see considerable opportunities to expand the value of the database for student research training.

(4). Other Collaborative Research Opportunities: The following list of other potential collaborative projects demonstrates the many interdisciplinary research opportunities that our program provides. These projects will be developed for student and pilot research studies in collaboration with outside agencies and will provide valuable practical experiences for students. Dr. Smith and Professor Baker serve as the main liaison with these organizations and will coordinate the research projects. Other projects will be developed in the future. "Seed" money in the form of support services and travel will be provided from the research training grant to enable the initiation of projects until outside funds can be obtained.

g. Mining and Construction: Dr. James Weeks, one of our faculty members, has done much research on injuries in the mining industry. This industry, unlike others, has a very complete and reliable database on occupational injuries, and provides many opportunities for students to be involved in research activities in what is one of the most hazardous industries in America today. Dr. Weeks also works with the research unit at the National Health and Safety Fund of the Laborers' International Union of North America, whose 500,000 members include 320,000 in the construction industry. The fund also is keen to collaborate with our program and involve students. Laborers in the construction industry have one of the highest injury rates, approximately 2 ½ times the average for the total U.S. workforce. Dr. Smith and Dr. Weeks are currently conducting a small study to look at fatalities among construction workers which is funded by the Center to Protect Workers Rights.

h. Other research opportunities: We have developed formal ties with a variety of industries where students can do research projects. These include: General Motors/United Automobile Workers Union, The Boeing Aircraft Corporation, DuPont, and the Red Cross. Dr. Smith is also part of an international network of occupational injury researchers and his contacts and their respective institutions provide a valuable opportunity for collaborative research projects, many of which will involve students. These include the Swedish National Institute for Occupational Health and Safety, the World Health Organization, the Australian National Institute of Occupational Health and Safety, and the New Zealand Accident Compensation Corporation. One of our graduating students has just been awarded a Fullbright Fellowship to do a postdoctoral year in New Zealand studying hospitalized occupational injuries.

Potential research projects for student research also include working with state and federal agencies. Two students have worked as summer interns at the NIOSH Division of Safety Research and numerous discussions have been held to strengthen our collaboration. Other potential projects include the National Highway Traffic Safety Administration (NHTSA), Maryland State Health Department, and the Colorado State Health Department. The Health Program Alliance is the part of the Department of Health Policy and Management at Hopkins that coordinates projects with a variety of state and local health departments. The State Health Departments in Maryland and New Jersey are eager to have our students work with them and the proximity of these states in our region should make this a valuable opportunity.

I. **Student research:** Faculty of the Occupational Injury Epidemiology and Prevention program have served as advisors or co-advisors on many student research projects - including: a case-control study to identify risk factors for occupational hand injuries in municipal workers; investigation of incident rates and risk factors related to injuries to correctional officers by inmates; analysis of agricultural equipment fatalities in the United States; a case-control investigation of slips, trips, and falls in painters in relation to their occupational exposures to solvent fumes; factors related to construction workers' safety behaviors; a case-control study of on-the-job injuries to firefighters; injury scaling for characterizing penetrating wounds in military personnel; policy analysis of traumatic workplace injury among the working poor; administrative factors in workplace injury control; an evaluation of OSHA enforcement; investigation of factors related to back injuries in firefighters in New York City; motor vehicle-related injuries to municipal workers; injuries to subsistence farmers in Papua New Guinea; the association between psychosocial factors in the workplace and the occurrence of cumulative trauma disorder symptoms in garment workers; hand injuries in the chemical industry; case-control study of fork-lift injuries; hand injuries in automobile manufacturing.

#### 4. Contributions to the Discipline

The unique contribution of this injury training program is its ability to integrate the public health/epidemiologic approach to injury prevention in the workplace with the strong traditions of ergonomics and other safety sciences. The unique feature of the program that distinguishes it from the traditional safety science programs is that it provides epidemiologists and other public health professionals in occupational injury prevention the knowledge and research skills to be part of the broader approach to reducing injuries in the workplace which requires working with all Occupational Safety and Health professionals.

Epidemiologic methods provide a proven scientific framework for the identification of occupational injury problems, the targeting of appropriate safety countermeasures, and the evaluation of the effectiveness of these interventions in reducing occupational injuries. Through the use of epidemiologic surveillance techniques detailed data on the nature and severity of occupational injuries can be obtained. These findings are then used as the basis for determining which occupational safety countermeasures should be applied to reduce or eliminate the occupational injury hazard or problem. Finally, epidemiologic techniques are used to evaluate the interventions developed by safety programs and to determine their effectiveness in reducing occupational injuries. Thus, there is an important link between occupational injury epidemiology and the other occupational safety sciences.

The integration of the strong interdisciplinary program of the Center for Injury Research and the ERC core programs has provided an opportunity to further expand the traditional educational programs for training in occupational injury epidemiology and prevention. Basic training in safety science has been included in the industrial hygiene program for some years. However, this program, as with most other safety training programs, deals mainly with industrial settings and does not address the ever-increasing number of occupational injuries occurring in non-structured work environments such as workplaces at risk for homicide. Our training program in occupational injury epidemiology and prevention builds on the well-established training opportunities here at the School and provides more in-depth teaching and research training in the prevention of occupational injuries. Because of the wealth of resources available, including the current ERC, The Johns Hopkins School of Hygiene and Public Health is uniquely qualified to develop and administer such a program in occupational injury training and research.

The major components of the program are the acquisition of core knowledge as reflected in the core curriculum; exposure to practical field experiences developed through seminars, courses, and field placements; and, for doctoral students, dissertation research in an applied area relevant to occupational injury prevention/safety sciences. Collaborative opportunities for student research are continually being developed with unions, industry, state health departments, NIOSH Division of Safety Research, and international agencies. The program includes a practical research component aimed particularly at: the design and implementation of appropriate surveillance systems for occupational injuries; studies of risk factors for injury occurrence; development of prevention programs based on principles of ergonomics, engineering, and safety-related disciplines; evaluation of interventions; and the development of occupational injury prevention policy.

The unique contribution of the research training is the diversity of research opportunities available to students. The emphasis on research skills training is the hallmark of the Hopkins educational experience. As the largest school of public health in the world, with over 300 full time faculty who are supported primarily by research funds, the opportunities for student research training are almost unlimited, including opportunities in industry, unions, state, local and federal government, and a variety of international experiences. Our students have both a national and international reputation, holding many important positions in public health. Our injury program graduates work in a variety of settings and are in demand. In fact, many of our graduates are hired to work on their thesis topic even before they graduate. Our graduates are trained primarily in injury epidemiology and prevention with additional training in ergonomics, safety engineering and other safety sciences to work with other occupational safety and health professionals as part of a team approach to preventing occupational injuries.

This training program has a strong multi-disciplinary approach, which draws upon many disciplines to train the leaders of a major new thrust to prevent occupational injuries. The program includes research training aimed particularly at: the design and implementation of appropriate surveillance systems for occupational injuries; studies of risk factors for injury occurrence; development of prevention programs based on principles of ergonomics, occupational psychology, engineering and safety-related disciplines; and evaluation of injury/safety engineering interventions.

## 5. Program Support

Faculty at Johns Hopkins receive the majority of their support (over 75%) from outside funded research projects. This often provides an opportunity for student involvement in projects. Students are encouraged to participate in any relevant faculty research projects. Current and past research projects that have outside support include the following:

- Back Injuries in Municipal Workers
- Other back injury projects
- Alcohol, drugs, and fatal occupational injuries
- Evaluation of fatal occupational injury reporting by death certificates
- Occupational injury fatalities in Maryland
- Shiftwork and occupational injuries
- Injuries to firefighters
- Earthquake injury epidemiology and post-disaster search and rescue
- Truck driver mortality
- Mortality and morbidity of pilots

- Work stress and risk of occupational injury
- Injuries to firefighters
- Occupational homicides
- A health surveillance system in the paper industry
- Post doctoral training in occupational epidemiology including injuries (DuPont) and a number of occupational epidemiology studies in the Department of Epidemiology
- Injuries in automobile manufacturing
- Flight instructor crashes
- Injuries to EMS workers and helicopter crashes
- Injuries to women in the military
- Fatal injuries in construction

## 6. Evaluation of Training Effectiveness

An important component of the program is a continuous evaluation of the quality of the program and whether its objectives are being met as outlined in the program plan. The ultimate measure of success is the quality of the graduates we produce, their progress through the program, and the quality and number of research publications generated. Feedback is actively solicited from preceptors of field placements as to the skills of our students and if they are meeting the needs of the agencies receiving our students. Knowledge acquisition is measured through usual assessment of students in each course. Student feedback is obtained through annual surveys and regular discussions with students. All students are required to produce written reports for all projects they work on in any substantive way. If possible these reports take the form of first drafts of manuscripts.

Each course offered in the School is also evaluated by the students. The injury prevention courses have always received extremely favorable evaluations. The results of these evaluations are published by the School and are used by incoming students for selection of appropriate courses. In addition several of our faculty have received "Golden Apple" awards for teaching excellence.

## **F. Program for Continuing Professional Education and Outreach**

### **1. Organization and Faculty**

The Continuing Education Program offers short courses to prepare environmental and occupational safety and health professionals for the ever-changing climate in research, regulations, compliance, health care delivery, and the corporate culture. The continuing education plan for the core program areas of Industrial Hygiene, Occupational Health Nursing, Occupational Medicine and Occupational Injury Epidemiology and Prevention is structured to provide short courses and workshops for physicians, nurses, industrial hygienists, safety engineers and other occupational safety and health professionals working to promote occupational and environmental safety and health.

Students can receive continuing education units from the relevant professional boards or associations, such as those in medical education, industrial hygiene, occupational health nursing, and safety. The program offers 15 to 20 courses per year which are primarily lecture-based, although some are augmented by laboratory components. Evaluation is an integral part of each course and is used to improve the quality of succeeding offerings and as a means of conducting an ongoing needs assessment. A two-week Summer Institute is offered which incorporates a multi-disciplinary and multi-professional approach to the continuing education of health and safety professionals. Although the format of the Summer Institute has generally been a selection of one-half day courses over a two week period, we expanded the options in 1996 by adding four two-day courses, each one-half day in length, for those who wish to add to their continuing education experience but who are unable to commit every day for two weeks. These courses met with a high degree of approval from participants.

Dr. Jacqueline K. Corn was Director of Continuing Education (C.E.) and Outreach Programs of the ERC and Director of Continuing Education for the Department from 1981 through 1994. After a brief hiatus and period during which one candidate did not successfully complete the probationary period for the position, a new director was hired. Ms. Diane Zerbe has been C.E. Director since July 1, 1995. We now have a fully qualified professional as C.E. Director and the program is once again operating at a high level of effectiveness after a period which exhibited a reduced number of courses and students during the transition described above.

All faculty in the ERC core areas and in the Department of Environmental Health Sciences are committed to the Continuing Education Program. ERC faculty are required to participate in continuing education programs. These faculty along with a number of individuals having expertise in associated disciplines such as toxicology, radiation health science, physiology and epidemiology give the program breadth of subject matter. The Continuing Education Program Director is a highly qualified individual with expertise in health care management, occupational health, and industrial hygiene. She is committed to the program and to maintaining its excellence. In addition, she recently graduated from the JHU Industrial Hygiene Program and as a result is familiar with the ERC, its faculty, and its goals.

In past years, it was the policy of this ERC to engage as course instructors only professionals holding full-time faculty appointments at Johns Hopkins University. That policy arose from our strong commitment to expertise in instruction and quality in course substance. However, the pressures that have been brought to bear on the time commitments of JHU faculty, competing fiercely for research funding while carrying an increasing teaching load in academic courses, have made it difficult to request a level of faculty support to maintain output of acceptable proportions for the ERC. This has led to

reevaluation of the faculty policy and a consequent change. We now include in our continuing education program faculty from outside of the university who are recognized as experts in the subject matter and in instruction. To ensure quality control of every course, however, a JHU faculty member must be involved in planning each course. One source of instructors for the cadre of instructors who may now present ERC courses is the significant group of Associate Faculty of each core program area; we will also consider additional appointments to this position.

## 2. Continuing Education by Program Area

### a. Industrial Hygiene

Continuing education courses in this program area are directed toward the recognition, evaluation, prevention, and control of factors in the workplace which may cause illness or injury. Examples of courses given during the grant period include topics such as air sampling techniques, ventilation principles and controls, and health, safety and environmental auditing. Regional involvement with the Chesapeake Section of the American Industrial Hygiene Association over a several year period has resulted in the co-sponsorship of annual Professional Development Programs with significant involvement of ERC faculty. JHU ERC Program Directors and faculty have served on planning committees, as faculty, and presented poster sessions. These programs have been one means by which ERC faculty have stimulated interdisciplinary interaction in the region; the ERC Continuing Educational Director has been responsible for incorporating into these professional meetings presentations by occupational health nursing, occupational medicine, and ergonomics ERC faculty in addition to industrial hygienists. Thus, the annual conferences have done much to demonstrate the collegial relationship of these disciplines.

Planned new courses include safety and health in confined spaces, industrial hygiene sampling techniques for safety professionals, health effects of indoor and outdoor air pollution, and radiation principles and controls. Additionally, a course presenting a comprehensive industrial hygiene review is being developed for those individuals intending to take the American Board of Industrial Hygiene Certification Examination. A symposium co-sponsored with the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) was presented with the focus on indoor air quality. A course entitled "Health Effects of Electric and Magnetic Fields--An Update" was presented in July, 1996. This course provided a review of past research and an update on recent and ongoing research on the health effects of extremely low frequency (ELF) electric and magnetic fields. In conjunction with this course, a public forum was held to provide an opportunity for a community discussion of this contemporary issue.

### b. Occupational Health Nursing

Courses are geared toward the practicing occupational nurse who requires continuing education to meet the challenges of providing occupational health care as well as acquiring management skills. Nurses are offered a variety of courses to enhance their understanding of toxicology, industrial hygiene and safety and injury prevention as well as worker health care. One course that has been designed specifically to meet regional needs is the Annual Review for the Occupational Health Nursing Certification Examination. This course takes place annually during six weekly evening sessions to allow: 1) working nurses the opportunity to attend without losing time from the job, 2) study time and time to develop questions between sessions, and 3) formation of ongoing study groups by geographical

areas if desired. The consensus has been that these courses are definitely "region-friendly" in comparison to more concentrated formats of COHN review courses, and they have led to lasting relationships with regional occupational health nurses who frequently call with questions and consultation issues.

As Director of Continuing Education for the Maryland Area Association of Occupational Health Nurses, Dr. Fitzgerald has brought an interdisciplinary perspective to planning, and has included ERC faculty in programs. Presentations have covered such topics as the evaluation and treatment of patients with multiple chemical sensitivities and the role of the occupational health nurse in ending domestic violence. Regional involvement of the OHN faculty centers on providing leadership in planning programs for the Maryland Area, Seneca Valley, and Metropolitan Washington Area and the Northern Virginia Associations of Occupational Health Nursing. In the short courses of the Summer Institute, Dr. Agnew directed a course on "Advanced Topics in Musculoskeletal Disorders", which was co-directed by Dr. Smith of the Injury Epidemiology Program. Future topics planned by the OHN core include courses in case management, topics in physical assessment, audiometric testing training, and occupational respiratory protection.

#### c. Occupational Medicine

Continuing education courses in this program area are designed to aid physicians who deliver occupational health care in industrial, governmental and clinical practice settings to acquire skills in both clinical and preventive occupational medicine. Recent courses have focused on multiple chemical sensitivities and on a case study approach to advanced topics in clinical, occupational and environmental medicine. The latter was an example of a new two-day offering during the Summer Institute to complement the full Summer Institute course titled "Fundamentals of Occupational Health". It received unanimously excellent evaluations. As Director of the Continuing Education Curriculum for the Maryland College of Occupational and Environmental Medicine, Dr. Mitchell has expanded the continuing education offerings, now jointly sponsored with the JHU ERC, and has also extended the target audience of specific offerings to a greater cross-section of occupational health professionals. An outstanding course on "Workers' Compensation in the State of Maryland" was presented not only to occupational medicine physicians, but also to occupational health specialists, nurses, attorneys, and primary care physicians. This is another example of JHU faculty carrying the concept of interdisciplinary teamwork into the practicing community.

Additional courses presented by the Occupational Medicine Program are being delivered to Maryland Occupational Safety and Health (MOSH) inspection personnel; topics have included carbon monoxide poisoning, the metabolic effects of noise, heat stress and cold stress, the health effects of asbestos, silica, fiberglass, and other man-made mineral fibers, and occupational respiratory pathogens and hazards in "sick buildings". Occupational Medicine residents are included in that teaching program, thus providing valuable teaching experience under the guidance of ERC faculty. Occupational Medicine faculty recently presented a one-day course entitled "Occupational Medicine Board Review" at the American Occupational Health Conference. The course was so well received that plans are underway to expand this preparation course in the coming year.

#### d. Injury Prevention and Safety Sciences

Continuing education courses in this program area are designed to assist safety and health professionals to acquire knowledge in the relevant areas of epidemiology as it relates to injury prevention, safety, and risk assessment. Recent courses have focused on ergonomics, "Advanced Topics in Musculoskeletal Disorders" (co-directed with OHN Program during the Summer Institute), and injury prevention. Faculty are drawn primarily from the JHU Center for Injury Research and Policy Injury. As this program area is developed as a true core component of the ERC, we anticipate growth is the area of continuing education. A course on injury epidemiology was taught for the Indian Health Service Environmental Health Offices, located in Rockville, Maryland. This course covered the general principles of injury epidemiology and prevention with a strong emphasis on occupational injuries and was presented at the University of Michigan Annual Graduate Summer Session in Epidemiology.

### 3. Other Program Developments

In 1992, a needs assessment of occupational safety and health professionals in NIOSH Region III was conducted by the JHU ERC Continuing Education Program. The purpose of the needs assessment was to update the educational offerings of the ERC by identifying topics of greatest interest and educational need. Results pointed to interest in topics relevant because of their: 1) recently emerging nature (e.g., ergonomics); 2) high prevalence (e.g., hearing loss) or 3) high cost (e.g., workers' compensation). A total of 1,118 persons responded representing all of the disciplines served by the ERC, including safety. Results were used to develop subsequent continuing education courses.

More recently, a small scale needs assessment was conducted in January/February, 1996 for members of the Maryland Area Association of Occupational Health Nurses as a joint effort between the JHU ERC and that organization. Surveys were mailed to 102 members of MAAOHN, with a response rate of 52% (n=53). Information on topics for CE will be used to plan upcoming programs for the organization and are useful to the ERC OHN Program.

In order to better serve the regional needs of health and safety professionals and improve our course offerings, we will be conducting continuing education needs assessments on an annual basis. Our plan is to take an innovative approach and focus in depth on a single professional group each year. Thus, the assessment process will be ongoing, and each discipline will be reevaluated every four years. This rotation of assessments will spread the use of resources over time. It will alert us to any sudden changes in the region because there is general consistency across disciplines in the topics cited as major needs. Because we have begun to survey occupational health nurses in Maryland, this will be the first group to be surveyed within the entire region. Mailing information on OHNs in NIOSH Region III has been obtained from the American Association of Occupational Health Nurses, and mailing labels will be purchased from this organization. A questionnaire will be mailed to members to assess continuing educational needs and to obtain suggestions for courses and the improvement of continuing education in this program area. In future years, professional organizations (i.e., American Industrial Hygiene Association, Board of Certified Safety Professionals, and the American College of Occupational and Environmental Medicine) will be contacted for information and mailing lists of their members in Region III.

In addition to this method of assessing the continuing education needs of our region, we include a brief needs assessment with all of our course evaluations. Our JHU NIOSH ERC brochure also contains a needs assessment and is periodically mailed and distributed at conferences.

Additionally, a Continuing Education Advisory Board has been newly formed to provide input, direction, and advice to the program; the board met for the first time in the spring of 1997. Members assist in the development of the needs assessment and will contribute to ongoing evaluation of the overall program. The board is composed of a representative member from industrial hygiene, occupational health nursing, occupational medicine, and safety science. The members will continue to provide advice to the CE Program at least twice annually.

#### 4. Outreach Program

##### a. Introduction

It is the goal of our outreach program to interact with and help other institutions or agencies located in Region III. Our outreach program also has national and international components as a direct function of the school's reputation as a leader in public health and the demand for faculty in leadership roles around the world. ERC faculty routinely interact with universities and schools, professional societies, labor organizations and corporations. Within our own institution, we have worked with faculty and students of the Schools of Arts & Sciences, Engineering, Medicine, and Nursing to increase curricular opportunities in occupational health and safety. Lectures and seminars and consultations have been conducted in Region III with professional as well as non-professional groups to raise awareness of health and safety issues.

Monthly seminars provide one means by which the ERC facilitates contact between occupational health professionals in the region, JHU ERC program members, and nationally and internationally renowned experts in the field. The ERC sponsors speakers who present topics of contemporary interest in occupational health and which are of relevance to all ERC program areas. Invitations are sent to a wide mailing list of individuals and organizations in the region so the audience is more broad than the typical academic seminar. The themes of the seminars are frequently controversial and stimulate thoughtful discussions regarding policy issues in occupational health. The seminars are followed by an informal afternoon discussion session with the speaker for those with additional questions.

The following summaries describe selected outreach activities in each program area, highlighting educational development, presentations, lectures, seminars, and consultations.

##### b. Industrial Hygiene

The Industrial Hygiene Program outreach activities have been broad in scope, drawing on the general expertise of the faculty in exposure assessment and control as well as their specific areas of interest in electric and magnetic fields, asbestos, ergonomics, aerosol sampling, and risk assessment. The addition to the faculty of Dr. Timothy Buckley, with interests in total exposure assessment, promises to expand the base of outreach contributions. Examples of activities of the program are presented here, with a focus on regional involvement.

Interactions with universities in the region have been numerous, including teaching, presentation of seminars, and educational program development at Johns Hopkins University (outside the School of Hygiene and Public Health), the University of Maryland Medical School, and Morgan State University. At Johns Hopkins, faculty lecture annually in an undergraduate winter intersession course "Introduction to Public Health" on the general topic of industrial hygiene, thus promoting an understanding of the profession and influencing the career choices of students. At the graduate level, the Industrial Hygiene Program is now working with the Johns Hopkins School of Engineering to develop a joint degree program for students interested in degrees in industrial hygiene and environmental engineering. Four students have received dual degrees; formalization of the program will logistically and administratively simplify the process while strengthening the complementary training.

At the University of Maryland School of Medicine, industrial hygiene faculty participate regularly in a preventive medicine course for second year medical students that includes a component on occupational health. The course includes industrial visits and emphasizes the team concepts of occupational health.

The list of presentations, lectures and seminars is also extensive. Examples of organizations and corporations to whom industrial hygiene faculty have spoken include the Society of Automotive Engineers, Eastern States Insulation Contractors Association, and Edison Electric Institute in Region III. Additional organizations include the Polyacrylate Association, the Hoechst-Celanese Company Annual Health and Safety Meeting, and the CNA Insurance Company. Faculty have made presentations in Region III at dinner meetings of the Delaware Valley, Central Pennsylvania, and Chesapeake (Maryland) sections of the American Industrial Hygiene Association. Similarly, they have spoken to the Susquehanna Valley Chapter of the Health Physics Society (Maryland, Delaware, Pennsylvania). Our program also will continue to co-sponsor and participate in the AIHA Chesapeake Section Professional Development Program.

An important activity that has increased awareness of health and safety issues has taken place locally at the secondary school level. Industrial hygiene faculty participated in the Woodlawn High School mentor program in Maryland.

Industrial Hygiene consultation activities have impacted corporations, labor organizations, and all levels of government agencies (federal, state, and local). Examples include such activities in Region III with the following corporations: Gillette Corporation, Baltimore Gas and Electric, Mobil Oil Corporation, Nordstrom Corporation, and the American Mining Congress. Faculty have also advised the International Brotherhood of Electrical Engineers on EMF issues and have collaborated with the Laborers Union to propose a medical surveillance program for former Department of Energy employees. Examples of government agencies to whom the program has provided consultation, again listing only Region III agencies, include: the U.S. Army Center for Health Promotion and Preventive Medicine, Environmental Protection Agency, Department of Energy, Department of Education, National Oceanographic and Atmospheric Administration, and the National Capitol Planning Commission at the federal level; the State of Maryland Power Plant Research Group, State of Maryland Hazardous Waste Task Force, Maryland Department of Natural Resources, and Maryland State Health Department at the state level, and City of Baltimore Office of Occupational Medicine and Safety on the local level.

Additionally, program faculty have contributed to overall awareness of occupational health and to the roles of occupational health professionals by participating in annual conferences on occupational

health and safety presented by the Office of the Mayor of Baltimore. They have given numerous interviews for news publications. An innovative outreach effort to be directed toward the community is the public forum on "Electric and Magnetic Fields and Health", held in Baltimore in conjunction with a scientific conference on EMFs in July, 1996.

Because national and international outreach is also vital to the programs at Johns Hopkins, a few important examples are mentioned here. National consultations included the Los Alamos Laboratory Health and Safety Group, the Association of Flight Attendants and the EXXON Corporation. The JHU ERC also co-sponsored the ASHRAE symposium entitled "Indoor Air Quality '96". A lecture entitled "Ergonomic Risk Factors Associated with Work in the Marine and Petroleum Industries" was presented at the University of Oklahoma, Health Sciences Center. A two-week course on "Aerosol Physics, Sampling, Lung Deposition and Toxicity" was taught to staff of the Center for Standardization and Radiation Safety Research, Indonesian National Atomic Energy Agency, Jakarta, Indonesia. Also, our faculty consulted for the World Health Organization, Western Pacific Region, to provide technical expertise to the Korean National Institute of Environmental Research on the issue of analytical procedures for man-made vitreous fibers.

### c. Occupational Health Nursing

Occupational Health Nursing outreach activities have also been broad in scope, with increased activity during this grant period targeted at involvement in educational development. Faculty interests in occupational health nursing research, work-related musculoskeletal disorders, aging workers, disabled workers, occupational asthma, and return to work issues have formed the basis for many of the program faculty presentations and consultations during the grant period. As with the Industrial Hygiene Program, the recruitment of an additional faculty member will increase outreach activity output to an even greater degree in the coming years. The focus on regional needs will continue to receive emphasis. Examples of activities of the Occupational Health Nursing Program are presented here.

The joint appointments of Drs. Agnew and Fitzgerald in the Johns Hopkins School of Nursing facilitate their involvement with undergraduate and graduate nursing students and has had a discernable impact on course and overall curriculum content in occupational health. In the five courses in which Dr. Fitzgerald teaches, she has introduced concepts of occupational health and has exposed students to clinical occupational health settings when studying physical assessment skills. Two clinical occupational health sites have been used for teaching nurse practitioners. She has also taught occupational health nursing concepts to nurse practitioner students at the University of Maryland. Faculty present general information on roles of occupational health nurses at Johns Hopkins, Georgetown University, and the University of Maryland Schools of Nursing on a regular basis, thus influencing the understanding of this area of nursing by those entering the profession.

Faculty have had an active role in the development of the joint MSN/MPH degree program at Johns Hopkins, with Dr. Agnew serving as the Chair of the Steering Committee. The curriculum of the joint program includes the option of combination with the Occupational Health Nursing Program, and also includes occupational health content for all others. Joint programs between Schools of Public Health and Nursing are being promoted by the Division of Nursing and are being developed or explored by a number of universities in the nation. Dr. Agnew provides advice nationally on joint program development, specifically addressing inclusion of occupational and environmental health content.

Occupational Health Nursing Program faculty influence the professional educational development of practicing occupational health nurses by means of their significant involvement with the local chapters of the American Association of Occupational Health Nurses. Dr. Fitzgerald plans the educational program for the Maryland Area chapter and faculty have planned and presented at meetings of both Maryland chapters as well as the Washington and Northern Virginia chapters of AAOHN in Region III. With regard to their influence on the professional educational education and development of other occupational health professionals, program members have presented at the AIHA Chesapeake Section Professional Development Conference and at grand rounds in the School of Medicine at the University of Maryland. Program faculty have also presented to students of the Department of Sociology at the University of Delaware.

Additional organizations and associations within Region III that have received presentations or seminars from the Occupational Health Nursing Program include the Safety Council of Maryland, Organization Resources Counselors (Washington, D.C.), and the Baltimore Area Labor Management Committee. Program faculty have spoken at the U.S. Navy Occupational Health Workshop in Norfolk, Virginia, the Baltimore Mayor's Conference on Occupational Health and Safety, and at two conferences in Washington D.C. on occupational stress that were co-sponsored by the American Psychological Association and NIOSH.

Consultation has been provided within the region to London Fog Corporation and the University of Maryland Technology Extension Services. Interaction with labor organizations in Region III has included the Seafarers International Union, the International Association of Fire Fighters, Service Employees International Union, and the Amalgamated Clothing and Textile Workers Union (currently the Union of Needletrades, Industrial and Textile Employees).

In addition to regional contributions, the Occupational Health Nursing Program faculty make major contributions at the national level. Dr. Fitzgerald served on the President's Committee on Employment of People with Disabilities, and is on the National Asthma Educational Program Coordinating Committee of the National Heart, Lung, and Blood Institute. Dr. Agnew was a participant in the workshop held by the Institute of Medicine on "Nursing and Occupational and Environmental Health" and recently participated in NIOSH activities to develop the National Occupational Research Agenda (NORA). She also served on the Safety and Occupational Health Study Section (NIOSH/CDC) and is on the NIOSH Board of Scientific Counselors.

#### d. Occupational Medicine

The Occupational Medicine Program serves as a highly regarded resource in regional, national and international forums. Core faculty are called on for their expertise in areas such as occupational epidemiology, lead intoxication, occupational pulmonary disease, musculoskeletal disorders, occupational health policy, and medical surveillance. Outreach activities of the faculty are extensive and becoming even more prevalent as the faculty establish themselves and the program as dynamic leaders in occupational medicine. The following summary presents selected examples of the program contributions.

An initiative that was begun three years ago at the Johns Hopkins School of Medicine, is a 12 hour unit on occupational medicine taught to second year medical students by the core Occupational Medicine

faculty. Program faculty also teach medical students at the University of Maryland for a total of at least 45 hours. These are new initiatives begun during the recent grant period. As another example of a new initiative in physician training, planning is underway for the development of a joint residency training program in occupational medicine and internal medicine. Educational development for practicing physicians in occupational medicine and in other specialties has been provided through several presentations at grand rounds in Region III hospitals, e.g., Fairfax Hospital (Virginia) and Prince Georges Hospital (Maryland), and by presentations at association meetings of family medicine physicians and emergency medicine physicians. Additionally, Dr. Mitchell is the Director of the Continuing Education Curriculum for the Maryland College of Occupational and Environmental Medicine.

Occupational Medicine Program faculty have presented at numerous organizations and associations in Region III. Selected examples include the Environmental Protection Agency, Housing and Urban Development, National Oceanographic and Atmospheric Administration, National Capitol Planning Commission, the Maryland Department of Health and Mental Hygiene and the U.S. Army Center for Health Promotion and Preventive Medicine (formerly the Army Environmental Hygiene Agency). Several presentations and consultations have been provided for the City of Baltimore. This has included a review of the occupational health program for city employees and consultation to the Employee Assistance Program for the Baltimore public school system. Dr. Mitchell has also provided consultation to schools with questions and problems regarding indoor air quality.

Worker training has been provided by core program faculty at the George G. Meany Center for Labor Studies in Maryland to groups such as the Machinists Union and Railway Workers. Other training was given to members of the International Chemical Workers Union. Fire fighter training has also been provided, and Dr. Weaver consulted to volunteer fire departments in western Maryland following possible exposures to toxic agents in a large apartment building fire. Dr. Weaver also serves on the Medical Advisory Board of the International Association of Fire Fighters. Additionally, she presented testimony on behalf of the IAFF on presumptive cancer legislation in the State of Virginia.

Faculty consult to corporations nationally and within Region III on a regular basis. Contact with news media has also been extensive. All program faculty have been interviewed by radio, television, and newspaper journalists on a variety of topics, including neurotoxic exposures, delivery of occupational health services, and Lyme disease. Dr. Mitchell participated in a one hour radio talk show in the Baltimore area on "Environmental Illness".

While the preceding examples are not exhaustive and stress contributions made in Region III, faculty have been leaders in their field at the national level as well. Additionally, Dr. Schwartz has made significant contributions internationally, including consultation on occupational health issues in India and presentation to the Indian Occupational Health Association in Bombay.

#### e. Occupational Injury Epidemiology and Prevention Program

Dr. Smith and Professor Baker are considered two of the nations's leading experts on occupational injury epidemiology and injury prevention. The program faculty have consulted to a number of state and local health agencies in the region on topics such as back injuries of Baltimore City employees, employee occupational injury claims in Maryland, and fatal occupational injuries in New Jersey.

Similarly, collaborative work has taken place on research projects. Examples are the back injury study and a study of motor vehicle injuries with the City of Baltimore. Dr. Smith works with the Maryland State Medical Examiner's Office on several issues such as the development of a system for improved reporting of occupational injury fatalities. Faculty also work with the Maryland Department of Health, Division of Injury Prevention and with the Maryland Occupational Safety and Health Program regarding case findings for occupational injuries.

Consultation and services have been provided by the Injury Epidemiology Program to corporations in the region. Examples are McCormick and Company (Maryland), Rohm and Haas (Pennsylvania), London Fog (Maryland), and DuPont Corporation (Delaware).

At the national level, the program places student interns at the NIOSH Division of Safety Research in Morgantown, West Virginia, and plans further collaborations with that agency. Dr. Baker took part as a representative of occupational injury researchers in the recent development of the National Occupational Research Agenda (NORA).

#### 5. Plan for Outreach Program

Outreach in Region III will be the primary goal of this program. Contact will be made with institutions in the region having Training Grant Programs to develop cooperative approaches to health and safety continuing education and awareness. Contacts with other institutions, professional societies and associations, labor unions, and industry will result in development of courses, seminars and workshops to strengthen the ability of the JHU ERC to meet the health and safety educational needs in Region III. Historically JHU has served as a resource for occupational health and safety nationally and internationally. That role will continue to be a component of our efforts.

Although the level of outreach activity of all core programs has been high, we plan to take steps to more actively pursue opportunities for external interaction and to do this with the greatest level of efficiency and, where possible, coordination among programs. The ERC faculty envision several ways in which outreach might be enhanced in a systematic manner. Therefore, Dr. Peter Lees, Deputy Director, will commit a portion of his time to enhancing the outreach program with the intention of hiring a part-time Outreach Director in future years who will be dedicated to that effort. This is a model which has worked extremely well in other funded Centers in the school where outreach has also been recognized as a critically important mission.

#### G. Conclusions

The Johns Hopkins Educational Resource Center continues to prepare leaders in industrial hygiene, occupational health nursing, and occupational medicine as well as occupational injury epidemiology. Students benefit from the core program disciplinary strengths and the associated strengths of other school programs. The core programs have grown and evolved. In all program areas, student numbers have remained steady or increased, while program applicants have generally increased. The Continuing Education Program experienced a change in leadership during this grant period and, after a brief period of reduced activity, the program is once again in full progress. While the ERC has always engaged in outreach activities, there has been an increasing focus on the needs of Region III and plans have been initiated to place further faculty emphasis on this effort. In all, the Johns Hopkins Educational Resource Center has demonstrated a high level of success in carrying out its mission during this grant period.

### III. Publications Resulting From Grant (trainee's name in bold)

**McArthur BR** and Lees PSJ: The Effect of Contact Time and Contact Pressure on the Transfer of Oil to Surface Sample Media. *Appl Occup Env Hyg* 10(1):23-28 (1995).

**Stewart PA**, Lees PSJ, and Francis M: Quantification of Historical Exposures in Occupational Cohort Studies. *Scand J Work Environ Health*, submitted (1995).

**Cheng K-H**, Cheng Y-S, Yeh H-C, Guilmette RA, Simpson SQ, Yang Y-H, and Swift DL: *In Vivo* Measurements of Nasal Airway Dimensions and Ultrafine Aerosol Deposition in the Human Nasal and Oral Airways. *J Aerosol Sci*, in press.

Bascom R, **Kesavanathan J**, Fitzgerald TK, Cheng K-H, and Swift DL: Sidestream Tobacco Smoke Exposure Acutely Alters Human Nasal Mucociliary Clearance. *Env Health Perspect* 103:1026-1030 (1995).

Swift DL and **Kesavanathan J**: The Anterior Human Nasal Passage as a Fibrous Filter for Particles. *Chem Engr Comm*, in press (1996).

**Cheng K-H**, Swift DL, Cheng Y-S, Su Y-F, and Yeh H-C: Local Mass Transfer Coefficients of the Human Nasal Passage from Measurements of Aerosol Deposition in a Nasal Cast. *Inhalation Toxicology* 6(Suppl):393-395 (1994).

Cheng Y-S, Smith SM, Yeh H-C, Kim D-B, **Cheng K-H**, and Swift DL: Deposition of Ultrafine Aerosols and Thoron Progeny in Replicas of Nasal Airways of Young Children. *Aerosol Sci Technol* 23:541-552 (1995).

**Cheng K-H**, Cheng Y-S, Yeh H-C, and Swift DL: Deposition of Ultrafine Aerosols in the Head Airways During Natural Breathing and During Simulated Breath Holding Using Replicate Human Upper Airway Casts. *Aerosol Sci Technol* 23:465-474 (1995).

**Cheng K-H** and Swift DL: Calculation of Total Deposition Fraction of Ultrafine Aerosols in Human Extrathoracic and Intrathoracic Airways. *Aerosol Sci Technol* 22:194-201 (1995).

Bascom R, Fitzgerald TK, **Kesavanathan J**, and Swift DL: A Portable Air Cleaner Partially Reduces the Upper Respiratory Response to Sidestream Smoke. *Appl Occup Env Hyg* 11:553-559 (1996).

Corn M and **Cohen R**: Real-Time Measurement of Sub-PPM Concentrations of Airborne Chemicals in Semiconductor Manufacturing. *J Exp Analysis Environ Epidemiol*, Suppl 1, 3:37-49 (1993).

Lees PSJ, Breyse PN, **McArthur BR**, Miller ME, Rooney BC, **Robbins CA**, and Corn M: End User Exposures to Man-Made Vitreous Fibers: I. Installation of Residential Insulation Products. *Appl Occup Environ Hyg* 88(12):1022-1030 (1993).

**Robbins CA** and Breyse PN: Effect of Polarity of the Adsorption Kinetics Vapor Mixtures onto Activated Carbon. *Am Ind Hyg Assoc J*, accepted (1995).

Corn M, **McArthur B**, and **Dellarco M**: Asbestos Exposures of Building Maintenance Personnel. *Appl Occup Environ Hyg* 9(11):845-852 (1994).

Correa A, Gray RH, **Cohen R**, Rothman N, Shah F, Seacat H, and Corn M: Ethylene Glycol Ethers and Risks of Spontaneous Abortion and Subfertility. *Am J Epidemiol* 143(7):707-717 (1996).

**Mylnarek S**, Corn M, and Blake C: Asbestos Exposure of Building Maintenance Personnel. *Regul Toxicol Pharmacol*, in press.

Menache MG, Hanna LM, Gross EA, **Lou S-R**, Zinreich SJ, Leopold DA, Jarabeck AM and Miller FJ: Upper Respiratory Tract Surface Areas and Volumes of Laboratory Animals and Humans: Considerations for Dosimetry Models. *Journal of Toxicology and Environmental Health*, submitted (1996).

**Owens SG**, Wallop J. Heart lung and lung transplantation. In Nolan MT and Augustine SM (eds) *Transplantation Nursing: Acute and Long-Term Management*. Appleton and Lange, Connecticut, 1994.

Baumgartner WA, **Owens SG**, Cameron DE and Reitz BA. *The Johns Hopkins Manual of Cardiac Surgical Care*. Mosby-Year Book, Inc., St. Louis, Missouri, 1994.

Walrath JM, **Owens SG**, Dziwulski E. Case-management - a vital link to performance improvement. *Nursing Economics*. 14:117-122, 1996.

Sithisarankul P, **Cadorette M**, Davoli C, Serwint J, Chisolm J and Strickland P. Plasma 5-aminolevulinic acid: A potential biomarker for effect of inorganic lead in children. (In press) .

Cattledge GH, **Schneiderman A**, Stanevich R, Hendricks S and Greenwood J. Nonfatal occupational fall injuries in the West Virginia construction industry. *Accident Analysis and Prevention* (In Press).

Hales T, Kiefer M, **Mitchell CS**, Salisbury S. Hazard Evaluation Report. Georgia Metals, Inc., Powder Springs, GA. Report No. HETA 91-393-2171. Cincinnati, OH. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, 1991.

**Mitchell CS**, **Cloeren M**, Israel E, Lazar C, Schwartz BS. Lyme disease in Maryland, 1987-1990. *Md Med J* 1992; 41: 391-396.

McDiarmid MA, **Weaver VM**. Fouling one's own nest revisited. *Am J Ind Med*. 1993; 24: 1-9.

**Mitchell CS**, **Cloeren MA**, Israel E, Lazar C, Schwartz BS. Lyme disease in Maryland, 1987-1990. *Md Med J* 1992; 41: 391-396.

**Fujikawa J**, et al. Oral erythromycin prophylaxis against streptococcal infection for penicillin-allergic military recruits: a randomized clinical trial. *J Infect Dis* 1992; 162: 162-165.

**Weaver VM**, McDiarmid MA, Guidera JA, et al. Occupational chemical exposures in an academic medical center. *J Occup Med* 1993; 35: 701-706.

**Mitchell CS, Cloeren MA, Schwartz BS.** Application of an injury surveillance system to occupational injuries at an industrial facility. *Accid Anal Prev* 1993; 25: 453-458.

**Patz JA.** Environmental health in family medicine. *Maryland Family Medicine*, Fall 1993; 6-9.

**Schwartz BS, McGrail M, Stewart W, Pluth T.** Comparison of measures of lead exposure, dose, and chelatable lead burden after provocative chelation in organolead workers. *Occup Environ Med* 1994; 51: 669-673.

**Stout RW, Mitchell SB, Parkinson MD, et al.** Viral hepatitis in the US Air Force, 1980-89: an epidemiological and serological study. *Aviat Space Environ Med* 1994; A67-71.

**Schwartz B, Mitchell C, Weaver V, Cloeren M.** Bacteria. In: Wald P and Stave G, eds. *Physical and Biological Hazards of the Workplace*. New York: Van Nostrand Reinhold; 1994: 318-381.

**Zangwill KM, Stout RW, Carlone GM, et al.** Duration of antibody response after meningococcal polysaccharide vaccination in US Air Force personnel. *J Infect Dis* 1994; 169: 847-852.

**Weaver VM, Groopman JD.** Fluorescence quantification of aflatoxin N7-guanine adducts. *Cancer Epidemiology, Biomarkers, & Prevention*. 1994; 3: 669-674.

**Balbus-Kornfeld J, Stewart W, Bolla KI, Schwartz BS.** Cumulative inorganic lead exposure and neurobehavioral test performance in adults: an epidemiologic review. *Occup Environ Med* 1995; 52: 2-12.

**McDiarmid MA, Weaver VM, Kessler E.** Industries associated with respiratory disease: hospitals and laboratories. In: Harber P, Schenker M, Balmes J (eds.). *Occupational and environmental respiratory diseases*. St. Louis: Moseby Yearbook, 1995.

**Kang DH, Rothman N, Poirier MC, Greenberg A, Hsu CH, Schwartz BS, Baser ME, Groopman JD, Weston A, Strickland PT.** Interindividual differences in the concentration of 1-hydroxypyrene-glucuronide in urine and polycyclic aromatic hydrocarbon-DNA adducts in peripheral white blood cells after charbroiled beef consumption. *Carcinogenesis* 1995; 16: 1079-1085.

**Kang DH, Rothman N, Cho SH, Lim HS, Kwon HJ, Kim SM, Schwartz BS, Strickland PT.** Association of exposure to polycyclic aromatic hydrocarbon (estimated from job category) with concentration of 1-hydroxypyrene glucuronide in urine from steel plant workers. *Occup Environ Med* 1995; 52: 593-599.

**McGrail MP, Stewart W, Schwartz BS.** Predictors of blood lead levels in organolead manufacturing workers. *J Occup Environ Med* 1995; 37: 1224-1229.

**D. Gary Rischitelli.** Developing a global right to know. *ILSA J Intl Comp Law* 1995; 2: 99-121.

**Schwartz BS.** Chlorine dioxide, chlorite, and chlorate. In: Mitchell CS, **Kuhnen A, Weaver VM, Austin-Dailey V, Schwartz BS.** Toxic gases. In: Frazier LM, Kage ML (editors). *Reproductive Hazards in the Workplace*. New York: Van Nostrand Reinhold, 1996, in press.

Mirensky Y, Schwartz BS. Acrylamide; Dioxane; Hydroquinone; Sodium azide. In: Mitchell CS, **Kuhnen A, Austin-Dailey V**, Mirensky Y, Schwartz BS. Other chemicals. In: Frazier LM, Kage ML (editors). Reproductive Hazards in the Workplace. New York: Van Nostrand Reinhold, 1996, in press.

Schwartz BS. Aniline and derivatives; N-Methylpyrrolidone; Nitrates, nitrites, and organic nitro compounds. In: Mitchell CS, **Kuhnen A, Austin-Dailey V**, Mirensky Y, Schwartz BS. Other chemicals. In: Frazier LM, Kage ML (editors). Reproductive Hazards in the Workplace. New York: Van Nostrand Reinhold, 1996, in press.

**D. Gary Rischitelli**. Licensing, practice, and malpractice in occupational medicine. *State Art Rev Occup Med* 1996; 11: 121-135.

**Balbus JM, Stewart W, Bolla K, Schwartz BS**. Simple visual reaction time in organolead manufacturing workers: influence of the inter-stimulus interval. Submitted.

**Balbus JM, Stewart W, Bolla K, Schwartz BS**. Simple visual reaction time and mixed organic and inorganic lead exposure: influence of different methods of modelling lead exposure, dose, and reaction time. Submitted.

**Sithisarankul P, Schwartz BS, Lee B-K, Kelsey KT, Strickland PT**. Aminolevulinic acid dehydratase genotype mediates plasma levels of the neurotoxin, 5-aminolevulinic acid, in lead-exposed workers. Submitted.

**Sithisarankul P, Schwartz BS, Lee B-K, Strickland PT**. Adjustment of urinary aminolevulinic acid levels improves the correlation with plasma levels and blood lead levels. Submitted.

McDiarmid MA, **Weaver VM**, Presson A, et al. OSHA hazardous drug handling. *Am J Hosp Pharm* 1996; in press.

**Weaver VM, McDiarmid MA**. Medical surveillance in health care workers. In: Fedoruk J (ed.). *Medical Surveillance*. Boca Raton, FL: CRC Press, in press.

Baker SP, Lamb MW, **Li G**, Dodd RS. Crashes of instructional flights. *Aviat Space Environ Med* 67(2):105-110, 1996 Feb.

Baker SP, **Halperin K**. Designing the death out of balloons [editorial; comment]. Comment on: *JAMA* 1995 Dec 13;274(22):1763-6. *JAMA* 274(22):1805, 1995 Dec 13.

**Damiano AM, Epstein LD, MacKenzie EJ**. A new model for category scaling data with an application to the development of health status measures in injury. *Med Dec Making* 15(2):170-179, 1995.

**Hinton RY, Lennox DW, Ebert FR, Jacobsen SJ, Smith GS**. Relative rates of fracture of the hip in the United States. Geographic, sex, and age variations. *J Bone Joint Surg Am* 77(5):695-702, 1995 May.

Johnson JV, Hall EM, Ford DE, Mead LA, Levine DM, Wang N-Y, Klag MJ. The Psychosocial Work Environment of Physicians: The Impact of Demands and Resources on Job Satisfaction and Psychiatric Distress in a Longitudinal Study of Johns Hopkins Medical School Graduates. *Journal of Occupational and Environmental Medicine*, 37, 1151-1159, 1995

Nuwayhid I, Stewart W, Johnson JV. Work activities and the onset of first-time low back pain among New York City firefighters, *American Journal of Epidemiology*, 137, 539-548, 1993.

Honkanen R, Koivumaa-Honkanen H, Smith, G. Males as a high risk group for trauma: The Finnish Experience. *Journal of Trauma* 1990;30:155-162.

Kirsch TD, Hilwig WK, Holder Y, Smith GS, Pooran S, Edwards R. Epidemiology and practice of emergency medicine in a developing country. *Ann Emerg Med* 26(3):361-7, 1995 Sep.

Kirsch TD, Smith GS, Holder YA, Edwards R. Injury surveillance in developing countries: use of A & E departments as sentinel sites. Manuscript in review.

Kishbaugh D, Dillingham TR, Howard RS, Sinnott MW, Belandres PV. Amputee soldiers and their return to active duty. *Mil Med* 160(2):82-4, 1995 Feb.

Klein-Schwartz W, Smith GS. Agricultural and horticultural chemical poisonings: mortality and morbidity in the U.S. Manuscript in review.

Krentz MJ, Li G, Baker SP. At work and play in a hazardous environment: Injuries aboard a deployed U.S. Navy aircraft carrier, Manuscript in review.

Langlois JA, Smith GS, Baker SP, Langley JD. International comparisons of injury mortality in the elderly: issues and differences between New Zealand and the United States. *Int J Epidemiol* 24(1):136-43, 1995 Feb.

Langlois JA, Buechner JS, O'Connor EA, Nacar EQ, Smith GS. Improving the E coding of hospitalizations for injury: do hospital records contain adequate documentation?. *Am J Public Health* 85(9):1261-5, 1995 Sep.

Li G, Baker SP. Injury patterns in aviation related fatalities: implications for preventive strategies. Manuscript in review, *Am J Forensic Med Pathol*, 1996.

Li G, Baker SP. Crash and violation experience of pilots involved in prior commuter and air taxi crashes - a historical cohort study. *Aviat Space Environ Med* 66(12):1131-1135, 1995 Dec.

Li G, Baker SP, Dodd RS. The epidemiology of aircraft fire in commuter and air taxi crashes. In press, *Aviat Space Environ Med*, 1996.

Li G, Baker SP, Frattaroli S. Epidemiology and prevention of traffic-related injuries among adolescents. *Adolescent Med: State-of-the-Art Review* 6:135-151, 1995.

- Marganitt B**, Mackenzie EJ, Smith GS, **Damiano AM**. Coding external-causes of injury (E-codes) in Maryland hospital discharges 1979-1988; a statewide study to explore the uncoded population. *American Journal of Public Health* 1990;80(12):1463-1466.
- Salive ME**, Smith GS. Death in Prison: changing mortality patterns among male prisoners in Maryland, 1979-87. *American Journal of Public Health* 1990;80:1479-1480.
- Honkanen R**, Smith GS. Impact of acute alcohol intoxication on the severity of injury: a cause-specific analysis of non-fatal trauma. *Injury* 1990;21:353-357.
- Suruda A**, Floccare D, Smith GS. Deaths and injuries from tire explosions during servicing. *Annals of Emergency Medicine* 1991;20:848-851.
- Honkanen R**, Smith GS. Impact of acute alcohol intoxication on patterns of non-fatal trauma: cause-specific analysis of head injury effect. *Injury* 1991;22:225-229.
- MacKenzie EJ, **Damiano A**, Miller T, Luchter S. Development of the Functional Capacity Index. In Press, *J Trauma*.
- MacKenzie EJ, Morris JA, Yasui Y, Jurkovich GJ, Cushing B, Burgess A, **McAndrew MP**, de Lateur B, Swiontkowski M. Factors influencing return to work following severe lower extremity trauma. Manuscript in review, *JAMA*.
- Ommaya AK**, Ommaya AK, Dannenberg AL, Salazar AM. Causation, incidence, and costs of traumatic brain injury in the U.S. military medical system. *J Trauma* 40(2):211-217, 1996 Feb.
- Perneger T**, Smith GS. The Driver's Role in fatal two-car crashes: a paired "case control" study. *American Journal of Epidemiology* 1991;134:1138-45.
- Smith GS, **Barss PG**. Unintentional injuries in developing countries: the epidemiology of a neglected problem. *Epidemiologic Reviews* 1991;13:228-266.
- Smith GS, **Langlois JA**, Buechner JS. Methodological issues in using hospital discharge data to determine the incidence of hospitalized injuries. *American Journal of Epidemiology* 1991;134:1146-58.
- Baker SP, Fowler C, **Li G**, **Warner M**. Head injuries in non-motorized informal recreation. A report to the George Snively Research Foundation. *The Johns Hopkins Injury Prevention Center*, 1992.
- Bhatnager MK**, Curtis MJ, Smith GS. Musculoskeletal injuries in the Afghan war. *Injury* 1992;23:545-48.
- Baker SP, Fowler C, **Li G**, **Warner M**. Head injuries in non-motorized informal recreation. A report to the George Snively Research Foundation. *The Johns Hopkins Injury Prevention Center*, 1993.

Baker SP, Lamb MW, Li G, Dodd RS. Human factors in crashes of commuter airlines. *Aviation, Space and Env Med* 64:63-68, 1993.

Johnson KC, Ford DE, Smith GS. An evaluation of the current practices of internists in residential fire injury prevention. *American Journal of Clinical Preventive Medicine* 1993;9:39-44.

Forjuoh SN, Smith GS. Case fatality rates by body part affected and trends in hospitalized burns in Maryland, 1981-90. *Burns* 1993;19:387-391.

Baker SP, Li G., Fowler C, Dannenberg AL. Injuries to Bicyclists: A National Perspective. A report to the Snell Memorial Foundation. *The Johns Hopkins Injury Prevention Center*, 1993.

Brenner RA, Smith GS, Overpeck MD. Divergent trends in childhood drowning rates, 1971 through 1988 *Journal of the American Medical Association* 1994;271:1606-8.

Baker SP, Li G, Lamb, MW, Warner M. Pilots involved in multiple crashes: "Accident Proneness" Revisited. *Aviation, Space and Env Med*, in press.

Frankenfield, DL, Baker SP. Epidemiology of hot-air balloon crashes in the U.S., 1984-1988. *Aviation, Space and Env Med*, in press.

Frankenfield DL, Smialek JE, Baker SP, Caplan YH, Lange WR. Fluoxetine and Violent Death in Maryland. *Forensic Sci Int*, in press.

Dannenberg AL, Baker SP, Li G. Intentional and unintentional injuries in women: an overview. *Annals of Epidemiology*, in press.

Li G, Baker SP. Crashes of commuter aircraft and air taxis: what determines survival? *J Occup Med*, in press.

Hinton RY, Lennox DW, Ebert FR, Jacobsen SJ, Smith GS. Geographic, age, and gender variation in the relative rates of hip fracture subtypes among the elderly: a national population study. *Journal of Bone and Joint Surgery* (In Press).

Langlois JA, Smith GS., Nelson DE., Sattin RW., Stevens JA., DeVito CA. Dependence in activities of daily living as a risk for fall injury events among elderly people living in the community. Submitted for Publication.

Langlois JA, Smith GS., Baker SP. A comparison of injury death rates for people 65 and older in New Zealand and the United States. Submitted for Publication.

Baker SP., Li G, Dannenberg AL, Fowler CJ, Vernick JS. Age and the bicyclist: should helmet laws include adults? Submitted for publication.

Li G, Smith GS, Baker SP. Drinking behavior in relation to cause of death among U.S. adults. *Am J Public Health* (in press).

**Li G, Baker SP.** Alcohol in fatally injured bicyclists. Submitted for publication.

**Barss P, Smith GS, Mohan D, Baker SP.** Injuries of Adults in Developing Countries: Epidemiology and Policy. New York: Oxford University Press in press.

**Veazie MA, Smith GS.** Heavy drinking, alcohol dependence and injuries at work among young workers in the United States Labor Force. Manuscript in review.

**Wagner RM, Jones NP, Smith GS, Krimgold F.** Study methods and progress report: A case-control study of the casualties with the Loma Prieta Earthquake: County of Santa Cruz. USGS Professional Paper (Loma Prieta) in press.

**Winston FK, Schwarz DF, Baker SP.** Biomechanical epidemiology: A new approach to injury control research. *J Trauma*, in press.

**Wagner RM, Jones NP and Smith GS;** Risk factors for casualties in earthquakes: The application of epidemiologic principles to structural engineering; Structural Safety 1994;13(3):177-200.

