FINAL PERFORMANCE REPORT

Northern California Education and Research Center
Center for Occupational and Environmental Health
University of California
School of Public Health
Berkeley, CA 94720

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Director

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ABSTRACT

The Northern California ERC was established in 1982. During the first twenty years of its existence, it has provided professional and research training at the graduate and post-graduate levels in industrial hygiene, occupational medicine, occupational health nursing, and ergonomics. A clinic administered by the Occupational and Environmental Medicine Division at UCSF provides interdisciplinary training for the residents and the nursing, industrial hygiene, and ergonomics students. In addition to academic training, the ERC provides a wide spectrum of continuing education and outreach activities.

These programs are located on two campuses of the University of California – Berkeley (UCB) and San Francisco (UCSF). Located at Berkeley are industrial hygiene, the Labor Occupational Health Program, ergonomics (jointly with UCSF) and the Continuing Education Program, including the Hazardous Substances Training Program. An Occupational Medicine Residency Program and the Occupational Health Nursing Program are housed in the Schools of Medicine and Nursing, respectively, at San Francisco.

Robert C. Spear, PhD has been the director of the ERC since its inception, and Suzanne Llewellyn, M.Ed., was the administrative officer for this length of time as well. In 2006, John R. Balmes, MD, assumed the director's role, and Marion Gillen, RN, MPH, PhD, former director of the occupational and environmental health nursing program, accepted the role of deputy director. Planning for both of these transitions was extensive, and both Dr. Spear and Ms. Llewellyn remain active in the ERC despite these role transitions.

The ERC is complemented by the state-funded Center for Occupational and Environmental Health (COEH), directed by Professor John R. Balmes for the last five years. COEH comprises the same programs as the ERC at Berkeley and UCSF, plus programs at UC Davis, and the education and outreach programs of the Labor Occupational Health Program. Most importantly, COEH provides funding for the faculty and staff infrastructure that supports the teaching programs at Berkeley, UC Davis, and UCSF

The University provides fully equipped teaching facilities at all of the ERC locations. They include classrooms, faculty and staff offices, laboratories, and clinical facilities. All of the campuses have an extensive library and are connected into the University's system-wide library. They also have essential computing resources.

ADMINISTRATION

The Northern California ERC and COEH are guided by an Executive Committee:

ERC & COEH Director and Past Director:	John R. Balmes, MD Robert C. Spear, PhD
Administrative Officer and Past Officer:	Marion Gillen, RN, MPH, PhD Suzanne Llewellyn, M.Ed**.**

Program Directors of the ERC:

Occupational Medicine:	John Balmes, MD
Occupational Health Nursing:	Oisaeng Hong, RN, PhD
Industrial Hygiene:	Mark Nicas, PhD, CIH
Hazardous Substances Academic Training	Mark Nicas, PhD, CIH
Ergonomics:	David Rempel, MD, MPH
CE/Outreach Program:	Robin Baker, MPH
Continuing Education:	Barbara Plog, MPH, CIH, CSP
Hazardous Substances Training	Barbara Plog, MPH, CIH, CSP

The ERC has also been advised by an external statewide advisory committee composed of representatives from each of the occupational health disciplines and from industry, labor, government and academia. The chair of this committee during the period of this report was M. Donald Whorton, MD, MPH, who is an occupational medicine physician. This committee is convened by the UC Vice President for Health Affairs and did not maintain a regular meeting schedule during the reporting period, so the COEH Director established a Northern California external advisory committee that can be convened more frequently.

Because the ERC has programs on two campuses of the University of California, we have made special efforts to integrate activities to create a whole that is greater than the sum of its parts. The Executive Committee has encouraged the development of interdisciplinary activities that cross program and campus lines, and some of these have become institutionalized. This team approach is also initiated by enterprising individuals who capitalize on the expertise of their colleagues and students from different programs.

Examples of integrative activities of the ERC include the clinic at UCSF which provides multidisciplinary training rotations for all disciplines, the MPH program at Berkeley which brings the medical residents into contact with the industrial hygiene and ergonomics students, special events and seminars sponsored by the ERC, service projects, faculty providing lectures in each others' classes, and research projects and COEH student award projects that support interdisciplinary collaboration among students and faculty.

Director's Overview
Program Status

In the five-year period covered by this report, the Northern California ERC has seen modest changes and significant strengthening. As detailed in the program reports the following has occurred:

- Leadership of the Industrial Hygiene program at Berkeley has continued under the direction of Mark Nicas for the duration of the cycle. During this time, new courses have been developed based on the changing nature of the workplace and feedback from prior reviews.

• Oisaeng Hong, RN, PhD, formerly the OEHN director at the University of Michigan, became the Program Director for the OEHN program. Rossana Segovia-Bain was hired as a new clinical faculty member in the OEH nursing program, and long-time clinical faculty member, Barbara Burgel, entered the doctoral program. Marion Gillen assumed the role of Deputy Director for the Center and is now based in Berkeley; she continues to work with doctoral students on qualifying examination and dissertation committees. The doctoral program has expanded significantly with eight students in 2006-2007.

• The faculty of the Occupational Medicine Program at UCSF has been relatively stable throughout the five-year reporting period. Two faculty have left the program. Dr. Dennis Shusterman accepted a position as Occupational Medicine Residency Director at the Univ. of Washington ERC, and Dr. Craig Steinmaus accepted a position with Cal/EPA, though he remains of the UCSF clinical faculty and continues to work with OEM residents. Dr. Robert Kosnik joined the faculty at the Parnassus site with a focus on the clinical activities at the UCSF site. A major collaboration with the OEH nursing program that provides services to low wage immigrant workers continued for four years until funding was exhausted. The interdisciplinary clinical training for residents and nursing students remains an active and viable part of the residency training program. In addition, plans to expand the research training focus were made and are scheduled to begin in Fall, 2007.

• The Ergonomics Program saw the loss of long-time ergonomist, Ira Janowitz, and faculty member, Karen King, but added Kristin Amlie, former ergonomist for the UCSF Medical Center. During the time period, several students received independent research awards.

• The Continuing Education Program assumed responsibility for the UC Berkeley-based Asbestos and Lead Paint Training Program during this time period, significantly expanding the number of course offerings and the breadth of professionals served.

Highlights

Bridges Newsletter

Since its inception the Center for Occupational and Environmental Health has published a quarterly newsletter which covers the accomplishments of students and faculty associated with the ERC. During 2006-2007, we expanded the newsletter by adding more researched-focused topics, and enhanced the visual nature of the newsletter in order to be more attractive to a broader audience. Newsletters are archived on the COEH web site: http://coeh.berkeley.edu/research/bridges/ and serve as an historical record of COEH and ERC activities.

Multidisciplinary Integration

We believe that one of our great successes has been our continued substantive collaboration among the faculty and students of programs that are separated by distance and time schedules (semester versus quarter systems). Despite these barriers, we can point to extensive interaction across program and campus lines. The following table of courses shows enrollment of students from multiple programs and courses offered by faculty of one program for students in another program.

Interdisciplinary Courses

Course Number and Title	***Students***	***Faculty***
M180 *Industrial Toxicology*	*OEHN, OEM, other UCSF students*	*Jewell (OEM)*
N271.06 *Mgmt of Clinical Occ'l Hlth Problems*	*OM Residents, OEHN*	*Burgel (OEHN) & Blanc (OEM)*
N273B *Issues in Occupational Health*	*OEHN attend OEM Grand Rounds as part of this course*	*Segovia-Bain & practitioners from multiple disciplines*
Joint UCSF/UCB: N274A and PH 268C *Health & Safety Hazards of the Workplace/Professional Practices*	*IH, OEHN participate in field trips together*	*Quinlan (IH), Plog (IH), Hong (OEHN))*
N274C / PH269B *Occupational Safety*	*IH, OEHN, Ergonomics*	*Plog (IH)*
N405 *OHN Practicum*	*OEHN: Internships with professional in all disciplines*	*Burgel, Segovia-Bain (OEHN)*
PH 204C *(offered every other year) Occupational Health Education*	*IH, Health Education students*	*Baker (LOHP)*
PH220C *Risk Assessment, Policy & Toxics Regulation*	*IH, Ergo, OM*	*Hammond & McKone (EHS)*
PH254A *Occupational & Environmental Epidemiology*	*IH, Ergonomics, OM*	*A. Smith & Steinmaus (Epid)*
PH 269C/BioE C279 *Occupational Biomechanics*	*Ergo, Bioengineering, OEHN, OEM, IH – job analysis & intervention design in the field with student from another discipline*	*Rempel (OEM, Ergo)*
PH 269D *Occupational Biomechanics*	*Ergo, Engineering, OEM*	*Rempel (OM, Ergo)*
N269E *Environmental Medicine*	*IH, OEM, other EHS students*	*Seward & Harrison (OEM)*
PH 270A *Exposure Assessment and Control*	*IH, OEM*	*Nicas & Spear (IH)*
PH270B *Environmental Toxicology*	*IH, OM, OEHN*	*M. Smith (Tox)*
PH271E *Environment and Policy*	*IH, OEM, Toxicology, Epidemiology*	*A. Kyle (EH Policy)*
PH 297 *Field Study in Ergonomics*	*Ergo, IH*	*Rempel (Ergo)*

PH 298 *Clinical Ergonomics*	*Ergonomics, OM*	*Rempel (Ergo) and physical therapists*
Joint UCSF/UCB: PH 298 and N404 *Clinical rotations (SFGH, Kaiser, Mt. Zion, and interdisciplinary)*	*OEHN, OM, IH*	*Segovia-Bain & Burgel (OEHN) Quinlan (IH), Jewell, Goldberg, Harrison, & Kosnik (OEM)*
PH 298 Group Study *Respiratory Health at an Automotive Manufacturing Facility*	*IH, OEM*	*Hammond, Balmes, Baker, Gold, Quinlan*
PH 298-002 *Exposure Assessment & Control II*	*OEM, IH*	*Nicas (IH)*

The number of ERC faculty making major contributions to the other ERC disciplines is impressive and demonstrates the extent to which the programs have become integrated, and indeed, inter-dependent. Ten of our core faculty contribute significantly to a program other than their home program, and faculty from all of the programs contribute to the ERC's Continuing Education Program.

Listed below are the permanently established ways in which the ERC is integrated. In addition to these, there are innumerable collaborations among the faculty and students resulting from their getting acquainted in formalized settings. Evidence of research collaborations can be seen in the publication record. Faculty also provides lectures for each other's classes and serves on dissertation committees across programs and campuses (e.g., Wilson (SPH) on Foushee (OEHN) committee; Krause (OEM) on Cheung, Lee, and Burgel (OEHN) committees; Blanc (OEM) on Mullen (OEHN) committee; Balmes (OEM) on Chen and Thompson committees; Harrison (OEM) on Roberts (OEHN) committee.

- **Summer Institute on Continuing Education** - Annual, weeklong set of courses open to the professional community in which faculty and students from all programs participate.

- **Clinical Training** - Training sites for the residents, nurses, industrial hygiene, and ergonomics students. Required clinic rotations bring the trainees together to collaborate on the evaluation of patients and their workplaces. For example, OEM residents and ergonomics students participate in Dr. Rempel's hand clinic at the UC Berkeley Tang Center; OEM residents and either IH or OEHN students participate in clinical case conferences, when feasible.

- Periodic **COEH Symposium -** in-depth discussion of topics of current interest to faculty, students, and government representatives. During this time period, three symposia were offered.

- COEH **Student Award Program** –$10,000 in funding from COEH and $5,000, when possible, from NIOSH, for up to three student projects involving interdisciplinary teams conducting a research, teaching, or service project. A minimum of two students from different disciplines is required, and preference is given to teams from more than one campus. The projects conducted by recipients of the award are showcased each fall.

- **Occupational Health Internship (OHIP) Program –** $5000 in funding from COEH to support one OHIP intern for a summer project. The purpose of OHIP is to help students learn more about the field of occupational safety and health from working people. COEH has successfully used this program to recruit new students into the OEHN program (Borden, current MS student and Goldstein and Chu, current Master's Entry into Nursing students) as well as provide current students (Lee – OEHN PhD program) with unique research and program planning activities.

- The **COEH web page** links the web sites of the COEH-affiliated programs on all three campuses: http://coeh.berkeley.edu, as well as to important initiatives such Wilson's Green Chemistry work, and Rappaport's Center for Exposure Biology.

- **Joint Grand Rounds, research seminars, journal club, workplace site visits, and case conferences** - the nursing and industrial hygiene students, as well as the residents participate in most or all of these activities.

- **Special Projects –** The program directors are committed to finding real world opportunities in which the students can work. Examples of recent projects include: 1) Providing health screening activities for workers exposed to arsenic through the Community Occupational Health Program; and 2) Educational activities to low wage workers such as janitors and cleaners; and 3) welding fume exposure and respiratory health assessment among workers at a local car manufacturing facility.

- **Interactions outside of the ERC** - Faculty who collaborate with colleagues across the campuses provide students with opportunities to broaden their perspectives. For example, ergonomics students have been involved in research projects with faculty from Hand Surgery, Bioengineering, and Orthopedics. Professors Spear, Rempel, and Koshland (all with engineering degrees) collaborate or have joint appointments in mechanical, biomedical, civil, and bioengineering as well as the Energy and Resources graduate degree Group. Dr. Faucett is heading up a project on interdisciplinary emergency preparedness on the UCSF campus, and is working with the CE program to provide continuing education activities to professionals in occupational safety and health and other areas.

- **Distance Learning** - We continue to seek new ways to broaden our reach beyond the Bay Area. The CE/HST program has developed two distance learning initiatives for nurses and physicians and in collaboration with the California Department of Public Health.

- **Outreach to other disciplines** - the desire to recruit high quality applicants to the programs as well as to expose students from other disciplines to occupational health principles has resulted in formalized activities targeting non-ERC students. For example, medical students rotate through the occupational medicine clinics, as do residents in family practice and internal medicine. In nursing, occupational health curriculum has been added to all nurse practitioner programs, including family and women's health. COEH supports one Occupational Health Internship Program (OHIP) each year, and is actively involved with students in the undergraduate public health degree program at Berkeley.

- **Joint Faculty Appointments** - Further evidence of the integration of our programs is seen in the institutional recognition of significant interdisciplinary collaboration in the teaching arena resulting in joint faculty appointments. Examples include: David Rempel (UCSF-OEM and UCB-Bioengineering); John Balmes (UCSF-OEM and UCB-SPH); Patty Quinlan (UCSF OEM and OEHN); and Barbara Plog (UCB-SPH and UCSF-OEHN); Scott Robinson (UCB-SPH and UCSF-OEM).
- **Research** – Major projects involving faculty and students (including residents) from at least two of the COEH collaborating campuses included:
    - Respiratory Problems Among Painters & Welders at NUMMI (17 students from UCSF, UCB, and UCD)—8 faculty (same campuses as students)
    - Fresno Asthmatic Children's Environment Study project (FACES) funded by California Air Resources Board (two students)—Tager (B), Balmes (SF) and Hammond (B);
    - Ergonomic Demonstration Projects in Agriculture funded by NIOSH (at least five MS and three PhD students) —Miles & Fathallah (D), Meyers (B, D), Faucett & Janowitz (SF);

- State Prison Healthcare Workers, funded by ASPH/CDC —Harrison (SF-OM), Nicas (B), White & Goldmacher (SF-OEHN).
- Exposure of auto repair workers to n-Hexane (two students)—Hammond (B) and Harrison (SF)

Enrollments and Graduates

Attachment #1 provides a comprehensive listing of students and residents who completed their training in one of the ERC-funded programs during the five-year reporting period. Eighty-six trainees completed the program during this time period, with 31 current students enrolled in all programs. During this period, trainees authored or co-authored more than 60 peer-reviewed publications and 13 book chapters. In addition, students in all programs made presentations at many regional, national, and international conferences.

Funding

For the most part, faculty and administrative staff in occupational health are supported by state funding provided by the University. COEH provides a significant portion of this support, including funding for most of the ERC program directors. These permanent positions provide stability to the teaching program.

NIOSH support of students and residents has been crucial to our success in developing a truly interdisciplinary program and in maintaining enrollments during difficult financial times. All of the programs depend heavily upon this support to recruit a qualified applicant pool for this career path and to attract particular students to their programs.

Each of our programs needs more NIOSH support than they are getting to match the increases in educational costs and to address the demand for occupational health specialists. While the UCSF residents have been exceptionally successful in competing nationally for the Occupational Physicians Scholarship Fund, they now anticipate having to turn qualified applicants away because of the lack of financial support. The nursing students, especially, are relying more heavily upon outside employment to support their schooling.

Federal training support for students is crucial to a career in occupational health to some extent because of the nature of students and residents who come to our programs. They are often older people who have work experience and discovered these fields after they have financial responsibilities for families and homes. They return to the University with considerable motivation, but need financial assistance. The occupational health specialties are not visible to undergraduates and few of our students come through the traditional educational pipeline. Hence, support while in school is essential, both for the student and for making entry into these professions feasible for those who are committed and who understand the nature of work and the needs of working people.

Supply and Demand

Demand for graduates of the Northern California ERC programs remains strong in all disciplines, in part because we are unable to graduate enough students to meet the ongoing demand. Despite constraints, the industrial hygiene program has expanded significantly during the last two years. A combination of low application rates and funding constraints for training in occupational medicine and ergonomics has been an intermittent problem. Given the national and state nursing shortage of nursing faculty, the expansion of the OEHN doctoral program is encouraging. During the past two years, enrollment in the OEHN master's program was lower than anticipated, but this trend has been reversed in the current time period. A large gap continues to exist between supply and demand of qualified OEHNs nonetheless. Graduates in

all programs continue to find desirable employment, able to stay in the Bay Area if they wish to do so. Numerous graduates have taken faculty positions in the past five years.

Future Plans

The ERC will continue emphasizing interdisciplinary activities and expanding educational opportunities as we work towards strengthening programs, where applicable, and developing resources and expertise to evaluate the social and behavioral aspects of occupational health. The medicine program plans to offer new practicum and research opportunities and a new track for physicians already in practice. Likewise, the OEHN program has developed a four-quarter specialist series that has already attracted one candidate. Clinical activities in collaboration with Glide Health Service are underway and provide rich experiences for students with low wage workers.

Further investment will be made to improve our central web site as well as individual program web sites, and to use the quarterly newsletter to foster research and teaching collaboration, encourage recruitment, especially of under-represented minority groups. Extramural research is thriving, but a lack of adequate funding to support larger enrollments continues to hamper all of the teaching programs.

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Occupational and Environmental Medicine Program
University of California, San Francisco and Berkeley
Final Progress Report 2002-2007

Highlights/Significant Results

The Occupational Medicine (OEM) Residency Program at the University of California, San Francisco (UCSF) continues to produce well-trained OEM physicians who have had considerable success obtaining positions in academia, private practice and governmental agencies during the 5-year period from July 1, 2002 to June 30, 2007. During the period, there have been 15 trainees: 10 graduates, 9 MPH degrees awarded, and two trainees who are preparing to graduate in 2008. Trainees have accepted post-residency positions in the following settings: academia (2), government (2), nongovernmental organizations (1), clinical practice (9), and research (1). All of the graduates of the program have been able to find desirable jobs without difficulty, often in the region.

The caliber of the OEM residents trained at UCSF is evidenced by the fact that applicants from our program have received 3 Occupational Physician Scholarship Fund (OPSF) awards. Recruitment of minorities and women remains highly successful, as nine (9) women and nine (8) individuals of minority status have completed training during this period.

Outcomes/Relevance/Impact

The trainees have published 35 research papers, presented 19 papers/poster/abstracts at national and regional meetings, and have written 10 book chapters. Trainee research has involved the following areas: musculoskeletal disorders, ergonomics, a call center intervention study, neurotoxicants, and arsenic in drinking water in the U.S. and internationally. A dental ergonomics research project resulted in the development of new hand tools for the industry.

In 2005, the program was reviewed by the Accreditation Council for Graduate Medical Education (ACGME) Residency Review Committee for Preventive Medicine and received full accreditation until 2010 for a total of eight residents per year (i.e., four in the academic year and four in the practicum year).

Despite the well documented shortage of OEM residency-trained, board-certified OEM physicians in the United States, a condition that has been present for many years, the overall application rate of young physicians to OEM residency programs remains low. Residency programs compete to recruit the best candidates. The UCSF program has continued to enjoy relative success in this endeavor during this reporting period. As noted above, the high number of Occupational Physician Scholarship Fund (OPSF) awards received demonstrates the quality of the applicants to the UCSF OEM Residency Program.

The program has been actively exploring the possibility of a separate practicum track for qualified residents who are interested in completing their practicum training over two years, made possible with the support of a sponsoring institution without the need for additional residency training funds. This new program would provide high-level training to mid-career physicians who are already practicing in the field and already hold an MPH degree. The presence of such applicants, who might otherwise find a return to graduate education impossible, would increase our annual cohort and number of graduates to better supply the state and nation with well-trained OEM specialists. This program is similar in concept to the

Occupational Health Specialist track proposed by the OEHN program which started in 2006-07 and already has had one successful applicant.

The OEM trainees have served vulnerable populations in the local community by participating in the Asian Immigrant Women's Advocates clinic and the Community Occupational Health Project's low wage worker's clinic. These clinics involved multidisciplinary practice with occupational and environmental health nursing students and faculty.

The training program and its faculty are actively involved in planning and providing continuing medical education for the local medical community, the western region, the United Sates, and internationally. The Grand Rounds program, Journal Club and Research Seminar are open to local physicians, nurses, industrial hygienists, and others. A special attempt is made to reach physicians in the East Bay area by scheduling quarterly evening events at UC Berkeley. The Advances in Occupational Medicine Conference is sponsored by the UCSF OEM Division and is held in San Francisco every 18 months. UCSF faculty members regularly serve on the planning committee of the annual Western Occupational Health Conference, as well as faculty members and sessions chairs. In 2004, a faculty member served as the conference chair. Two faculty members have served on the Board of Directors of the Western Occupational and Environmental Medicine Association and one has served as President of the American College of Occupational and Environmental Medicine. Faculty have planned and presented sessions at the American Occupational Health Conference and other national meetings. They have also participated in international meetings on ergonomics, occupational medicine, and in competency-based assessment of occupational medicine training. They are also active in ACOEM, the American Thoracic Society, and other national and international organizations.

The overall impact of the program includes the increased number of Board-certified occupational medicine physicians in the region, an active continuing medical education program internally and externally, a multidisciplinary consulting clinic practice (MDC) that receives referrals from various local, state and federal agencies, local physicians, UCSF departments, the Pediatric Environmental Health Specialty Unit (PEHSU), attorneys and individuals. The MDC clinic also performs evaluations for World Trade Center workers from the Red Cross and the Federal Emergency Management Agency. Additionally the impact can be measured by the publications and presentations that residents and faculty have made.

Technical Report

The primary goal of the Occupational Medicine Program at UCSF is to continue to recruit and train physicians who will become future leaders of the field. A specific objective is to provide high quality academic and practicum training experiences. The expected outcomes include high levels of attainment in the ACGME General Competencies and significant exposure to and competence in the vast majority of the ACOEM OEM Competencies. The utilization of these benchmarks guides the training program and allows for periodic assessment of the progress of the residents. Upon graduation, it is expected that the resident is capable of performing as a highly competent OEM specialist and will be well prepared for the American Board of Preventive Medicine (ABPM) examination. The UCSF OEM program actively seeks multidisciplinary training opportunities for residents and continues to seek enhancement of training opportunities through development of new practicum rotations, industrial site visits, and broader didactic instruction. NIOSH traineeship support is essential for UCSF to continue to meets the training goals and objectives set forth by the program.

Briefly, the basic two-year program of the UCSF OEM Residency includes the following: two months of summer didactic instruction and industrial site visits in both years; a nine-month program at the University of California at Berkeley (UCB) School of Public Health culminating in the award of a Master of Public Health degree; a practicum year with four months of core OEM rotations, with two months of public health, three months of elective, and two months of research content. OEM residents evaluate and treat patients in the clinics throughout the two years of the program, as well as attend OEM Grand Rounds twice monthly and Case Conferences weekly. In addition, residents participate in monthly journal club and research seminars. Each resident is expected to make a formal presentation at OEM Grand Rounds and at the OEM Research Seminar before the end of their training program.

Residents are required to take a 10-week UCSF course with OEHN students co-taught by OEM and OEHN faculty that is entitled “Clinical Management of Occupational Health Problems.” There are additional courses the residents are required to attend such as the annual 2-day UCSF Occupational and Environmental Medicine CME and COEH Ergonomics courses as well as those given during the COEH Summer Institute on topics such as toxicology, workers’ compensation, and disability evaluation. Interdisciplinary training is included in UCSF courses, COEH conferences, and through multidisciplinary clinic activities.

The residents are evaluated according to the ACGME competencies on a monthly basis in clinic and rotations, as well as on the ACOEM competencies on a semi-annual basis. These evaluations serve to provide timely information to the trainee and the program director, as well as produce evidence of progressive improvement and responsibility.

A major factor that has severely affected the UCSF OEM Residency Program has been the UC-mandated increase in resident stipends as well as housing and relocation allowances. A second factor is the rapidly rising tuition at the UCB SPH which now includes a professional school fee for the students in the MPH track. Out-of-state tuition has also increased to an amount that is now twice that of the in-state fees. These factors have made it increasingly difficult to support our current number of trainees. The UCSF Department of Medicine has assisted with salary differentials and tuition support as well as supporting the Program Director and Program Coordinator.

Clinical Training:

During both years of the program, high-quality clinical experiences are using a multi-disciplinary training approach. The Occupational Health Service at San Francisco General Hospital and The Kaiser-Permanente Occupational Health Clinic in downtown San Francisco have been the primary clinical training sites for OEM residents during the past five years. The OEM faculty practice clinic, the MDC, is operated at the Mt. Zion campus of UCSF. This site provides for multidisciplinary clinical training of OEM, OHN, IH, and ergonomics students. There is also a weekly MDC case conference. Other clinical locations include the UCSF Hand Clinic, Dermatology Clinic, Acute Injury Clinic, and the UCB Upper Extremity Clinic.

Research Training:

Residents are required to participate in OEM research activities. The research training activities of core UCSF faculty members are focused on three main areas: occupational and environmental lung diseases, musculoskeletal disorders of the upper extremity, and occupational and environmental epidemiology on topics such as arsenic-related cancers, low back injury, disability, cardiovascular disease, and air pollution health effects. Residents seek an

OEM faculty research mentor in their first year of training and begin to prepare for the second year, which includes two protected months for research.

The Training in Clinical Research (TICR) course of the UCSF Department of Epidemiology and Biostatistics meets in the early part of the practicum year and is a requirement of the OEM Residency program. As part of this training, residents are required to develop and present a proposed research design and protocol for a relevant project. There is peer review and faculty supervision of trainee projects, which forms the basis of their mentored research project. After research projects have been finalized, trainees work closely with their research preceptor over the course of the practicum year. Continued research training is provided during the monthly Research Seminar and Journal Club. There is a concurrent UCSF course on bioethics and the responsible conduct of human research that the OEM residents are required to take. The UCSF Committee on Human Research also requires that all principal investigators and key researchers participate in training on human subjects research.

Research activities are extensively supported by extramural funds and residents may apply for COEH student award funds. Over the last 5 years, five OEM residents have received NORA support and two residents have received COEH student awards.
Principal faculty research mentors include Drs. Balmes, Blanc, Eisner, Goldberg, Krause, Rempel, and Steinmaus. State and federal agencies have supported the occupational and environmental health research by trainees in addition to NORA funding. All research trainees of the OEM program are expected to play a major role in the preparation of research publications as well as present papers, posters and abstracts.

Academic Training:

The environmental health sciences curriculum at UCB continues to meet the requirements of the ACGME and the ABPM for OEM resident training. Additional course opportunities have been made available on topics such as environmental health policy and advanced occupational epidemiology. There is also additional academic training available at UCSF in research methods, bioethics, and academic career development. Drs. Seward, Rempel, and Balmes continue to hold appointments at both UCSF and UCB and actively maintain contact with the trainees during residents' time at UCB.

Practicum training:

New courses and rotations have been developed to meet the educational needs and goals of our trainees and to better prepare them for the ever-increasing scope of the specialty. New rotations have been established with an occupational neurotoxicologist on faculty, and with the World Health Organization in Geneva**,** Chevron Employee Services in Houston, and State Compensation Insurance Fund in San Francisco. Practicum sites also provide trainees with opportunities in medical management, manufacturing, biotechnology, the semiconductor industry, research laboratories, high-energy physics, ergonomics, public health, environmental health, medical toxicology, and clinical and consulting occupational medicine. Trainees create a rotation schedule that balances research and clinical occupational medicine with public health, corporate medical directorship, consulting practice, environmental medicine, and medical management.

UCSF is a site for a Pediatric Environmental Health Specialty Unit (PEHSU). The Northern California PEHSU is funded by the Agency for Toxic Substances and Disease Registry and the U.S. Environmental Protection Agency through a cooperative agreement with the Association of

Occupational and Environmental Clinics (AOEC). Dr. John Balmes is the principal investigator for this unit. The primary function of the PEHSU is to provide education and outreach to community physicians through consultative services, mostly by telephone, for pediatric environmental health problems with a focus on environmental triggers of asthma. The PEHSU offers experience with environmental exposures and childhood illness to our residents.

The UCSF Medical Toxicology fellowship is under the auspices of the ACGME and is formally affiliated with the OEM Residency Program. A joint training program in occupational and environmental medicine and toxicology has been developed. The first trainee completed the combined training in 2006 and has entered academia after completion of the program. The joint training program requires a research project on a topic that involves both OEM and medical toxicology, thereby satisfying the research requirements of both programs.

Publications Co-authored or Authored by Trainees

The following is a list of publications on which students or residents are authors. The students' and residents' names are in **bold** and core faculty names are underlined.

1. Arredondo SA, Latini DM, Sadetsky N, Kawakami J, Pasta DJ, DuChane J, Carroll PR, and the CaPSURE™ Investigators. Quality of Life for Men Receiving a Second Treatment for Prostate Cancer. Journal of Urology, January 2007.

2. Latini DM, Chan JM, Cowan JE, **Arredondo SA**, Kane CJ, Penson DF, DuChane J, Carroll PR, and the CaPSURE Investigators. Quality of Life for Men with Prostate Cancer and Diabetes: A Longitudinal Analysis from CaPSURE. Urology, December 2006.

3. Marr PL, Elkin EP, **Arredondo SA**, Broering JM, DuChane J, Carroll PR. Comorbidity and Primary Treatment Selection for Localized Prostate Cancer: data from CaPSURE. Journal of Urology, April 2006.

4. Arredondo SA, Filipowski D, Sadetsky N, Latini DM, DuChane J, Mark S. Litwin, Carroll PR, and the CaPSURE Investigators. The Impact of Comorbidity on Health-Related Quality of Life in Men undergoing Radical Prostatectomy: Data from CaPSURE. Urology, March 2006.

5. Steinmaus C, **Carrigan K**, Kalman D, Atallah R, Yuan Y, Smith AH. Dietary intake and arsenic methylation in a U.S. population. Environ Health Perspect. 2005 Sep;113(9):1153-9.

6. Steinmaus C, **Carrigan K**, Kalman D, Atallah R, Smith AH. Diet and Arsenic Methylation in a US Population. *Environmental Health Perspectives* 113:1153-59, 2005

7. Das R, Materna B, Windham G, Beckman J, Marcellini M, **Carrigan K**, Ibarra M, Sumner A. Worker illness related to ground application of pesticide-Kern County, California, 2005. MMWR. 2006 May;55(17):486-8.

8. Steinmaus C, Bates MN, Yuan Y, Kalman D, Atallah R, Rey O, Biggs ML, Hopenhayn C, Moore L, **Hoang B**, Smith AH, Arsenic Methylation and Bladder Cancer Risk in Case-Control Studies in Argentina and the United States. *Journal of Occupational and Environmental Medicine* 48:478-88, 2006

9. Bahr JM, Dalponte M, **Janssen S**, Bunick D, Nakai M. Ion Transporters for Fluid Reabsorption in the Rooster (*Gallus domesticus)* Epididymal Region. *Animal Reprod Sci*, 95:331-37, 2006.

10. **Dong H**, Barr A, Loomer P, **Laroche C**, Young E, Rempel D. The effects of periodontal instrument handle design on hand muscle load and pinch force. J Am Dental Assoc 2006, 137(8):1123-30.

11. Laroche C, Barr A, **Dong H**, Rempel D. Effect of dental tool surface texture and material on static friction with a wet gloved fingertip. J Biomechanics 2007; 40(3):697-701.

12. **Dong H**, Loomer P, Barr A, **Laroche C**, Young E, Rempel D. The effects of tool handle shape on hand muscle load and pinch force in a simulated dental scaling task. Appl Ergonomics 2007; 38:525-531.

13. Schlossberg E, **Morrow S**, Llosa A, Mamary E, Dietrich P, Rempel D. Upper Extremity Pain and Computer Use among Engineering Graduate Students. Am J Ind Med 2004, 46(3):297-303.

14. Steinmaus C, Moore L, **Shipp M**, Kalman D, Biggs ML, Hopenhayn C, Bates M, Zheng S, Smith AH. Genetic Polymorphisms in MTHFR 677 and 1298, GSTM1 and T1, and Metabolism of Arsenic. *Journal of Toxicology and Environmental Health*, 70:159-70, 2007

15. Silvestri S, Ralls GR, Krauss B, **Thundiyil JG**, et al. "The Effectiveness of Out-of-Hospital use of Continuous End-Tidal Carbon Dioxide Monitoring on the Rate of Unrecognized Misplaced Intubation Within a Regional Emergency Medical Services System." *Annals of Emergency Medicine.* 2005; 45(5): 497-502.

16. Thundiyil JG. "Lithium Toxicity." Call Us. The Official Newsletter of the California Poison Control System. Volume 1(6), November 2003. http://www.calpoison.org.

17. Thundiyil JG. "Sulfonylurea Toxicity." Call Us. The Official Newsletter of the California Poison Control System. Awaiting publication. . http://www.calpoison.org

18. Thundiyil JG, Anderson IB, Stuart P, Olson KR. Lamotrigine-induced seizures in a child: a case report and review of the literature. Clinical Toxicology. 2007; 45(2): 169-172.

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20. Thundiyil JG, Solomon GM, Miller MD,. Transgenerational exposures: persistent chemical pollutants in the environment and breast milk. *Pediatric Clinics of North America*. 2007; 54(1): 81-101.

21. Thundiyil JG, Yuan Y, Smith AH, Steinmaus C. Seasonal variation of arsenic concentration in wells in Nevada. *Environmental Research*. 2007 Jul; 104(3): 367-373.

22. Thundiyil JG, Yuan Y, Smith AH, Steinmaus C. Seasonal Variation of Arsenic Concentration in Wells in Nevada. *Environmental Research*, 104:367-73, 2007

23. Steinmaus, C., **Wang, C.**, and Smith, A.H. Vitamin E and Lung Cancer Meta-Analysis – A Quantitative Analysis of the Current Epidemiologic Literature on Vitamin E and Lung Cancer. Submitted, publication pending

ABSTRACTS

1. Arredondo SA, Latini DM, Sadetsky N, Kawakami J, Pasta DJ, DuChane J, Carroll PR, and the CaPSURE™ Investigators. Quality of Life for Men Receiving a Second Treatment for Prostate Cancer. Conference on Cancer Nursing Research, Hollywood, February 2007. (ABSTRACT)

BOOK CHAPTERS

1. Solomon GM, **Janssen S.** Talking with patients and the public about endocrine disrupting chemicals. In: *Handbook of Endocrine Disrupting Chemicals*. Ed. Gore A. Humana Press, Totowa, NJ. (in press).

2. Janssen S, Fujimoto VY, and Guidice LC. Endocrine Disruption and Female Reproductive Outcomes. In: *Handbook of Endocrine Disrupting Chemicals*. Ed. Gore A. Humana Press, Totowa, NJ. (in press).

3. Goldberg, R. and **Janssen, S.** Reproductive Hazards. In: *Handbook of Agricultural Medicine.* Ed. James E. Lessenger, Springer, New York, 1st edition, 2006.

4. Thundiyil JG, Olson KR. "Lithium Toxicity." In Hadaad LM, Winchester JF, eds. Clinical Management of Poisoning and Drug Overdose, 4th ed. Philadelphia, PA: W.B. Saunders Company, chapter accepted for publication in 2005.

5. Thunidiyil JG, Beauchamp JK, Olson KR. "Approach to Poisoning and Overdose." In Wachter LM, Goldman L and Hollander H, eds. Hospital Medicine. Philadelphia, PA: Lipincott Williams and Wilkins, 2005.

6. Thundiyil, JG. "Halons and Freons." In Olson KR ed., Poisoning &Drug Overdose, 5th edition. San Francisco, CA: McGraw-Hill Co., 2007.

7. Thundiyil, JG. "Trichloroethane, Trichloroethylene, and Perchloroethylene." In Olson KR ed., Poisoning &Drug Overdose, 5th edition. San Francisco, CA: McGraw-Hill Co., 2007.

8. Thundiyil JG, Ralls G, Silvestri S. Orange County EMS Hazardous Materials Protocols. 2005.

9. Giordano PA, Lyon C, Wu T, **Thundiyil JG**, Weber K, Falk J. Board Review Questions in Emergency Medicine. Resident & Staff Physician 53(5), May 2007.

10. Thundiyil JG, Stober J, Besbelli N, Pronczuk J. Case definition matrix for acute pesticide poisoning. Accepted for publication in *Bulletin of the World Health Organization* in September, 2007.

11. Wang, C., **Laroche, C**., Levin, C., and Maibach, H. Transdermal Drug Delivery System- An Overview. Chapter 9, Dermatotoxicology, 7th Edition, Zhai, H. and Maibach, H.I., Eds., CRC Press, Boca Raton, *publication pending* 2006

12. Wang, C., Maibach, H. Vulvar Toxicology. Chapter 18, Women's Health- The Vulva: Current Knowledge and Understanding, 1st Edition, Farage, M. and Maibach H., Eds., Taylor and Francis, 2006, *publication pending*

PRESENTATIONS

Abbah:

1. Abbah E, Garcia M, Harris C, Goldberg R, Krause N, Rempel D. Impact of hand or wrist pain on work function among workers performing hand intensive work. PREMUS 2007 (Prevention of Musculoskeletal Disorders), 27 August 2007. Boston.

2. Abbah E, Rempel D, Goldberg R, Krause N. Impact of hand/wrist pain on work function among blue collar workers. American Occupational Health Conference, 2007, New Orleans.

Carrigan:

3. Steinmaus C, **Carrigan K**, Kalman D, Atallah R, Yuan Y, Smith AH. Dietary intake and arsenic methylation in a U.S. population. Environ Health Perspect. 2005 Sep;113(9):1153-9.

Janssen:

4. August 10, 2006 Presentation: "*PVC and DEHP in medical devices: Problems and Solutions*", session sponsored by San Francisco Dept. of Environment for city hospitals including representatives from UCSF, San Francisco General Hospital, and St. Luke's Hospital.

5. September 14, 2006. Presentation: "*Hormonal Effects of Chemical Pollutants – Endocrine Disruptors and Human Health*". Session held at the University of California, Berkeley, School of Public Health for course entitled "Current Topics in Environmental Medicine".

6. September 19, 2006 Presentation: "*Building Green Hospitals: Healthy Alternatives for Interior Flooring and Finishing*". Session focused on toxic building materials including phthalates, halogenated flame retardants, and semi-volatile organic compounds. Session sponsored by San Francisco Dept. of Environment and attended by architects from all over Bay area as well as some hospital representatives.

7. September 27, 2006 Presentation: "*Chemical Exposures and Chronic Disease*" given at a side event sponsored by the International POPs Elimination Network during Forum V of the Intergovernmental Forum on Chemical Safety. Discussion focused on heavy metals (Pb and Hg) and pesticides (DDT and lindane) and endocrine disruption. Session attended by ~80 people including international NGOs, delegates to the Forum representing the Ministries of Environment from their respective countries, physicians and scientists.

8. November 21, 2006 Presentation: "*First do no Harm: The problems with using PVC and plasticizers in the Healthcare Settings and Alternatives to their uses."* Grand Rounds presentation for the Pediatrics Dept. at San Francisco General Hospital. Attended by staff physicians, residents, medical students, nurses and purchasing staff.

9. January 29, 2007 Led a lunch circle discussion at the UCSF-CHE Summit on Environmental Challenges to Reproductive Health and Fertility entitled, ***"****CHE's Toxicant and Disease Database, and Online Abstracts and News Libraries***"**. CHE's science-based, searchable database (http://database.healthandenvironment.org/index.cfm) summarizes links between chemical contaminants and approximately 180 human diseases or conditions. CHE's Online Abstracts and News Libraries

(http://www.environmentalhealthnews.org/topic.jsp?term=Topic%2FcheFertility), developed with EnvironmentalHealthNews.org, catalogues research and news stories related to environmental chemical factors in fertility and early pregnancy compromise.

10. January 30, 2007 Co-facilitated a break out session at the UCSF-CHE Summit on Environmental Challenges to Reproductive Health and Fertility entitled **"**Critical research directions and collaborations". Discussion of the most critical research directions/tools identified at the meeting; key research areas that basic scientists and epidemiologists, clinical researchers, and patient/community representatives might work on together; and key questions to be addressed in future research. Participated in plenary discussion afterwards to summarize group discussion.

11. March 15, 2007. Presentation, "*Talking to patients about endocrine disruption*" Talk at SEIU Local 790 conference "What is a healthy hospital? A conference for health care workers on environmental issues facing healthcare institutions", SEIU headquarters San Francisco.

12. April 19, 2007. Presentation, "*Exposure to and health effects of halogenated fire retardants*" given at workshop entitled: "The Fire Retardant Dilemma: Part II." UC-Berkeley.

13. May 30, 2007. Poster presentation, *"Policy Implications of endocrine disrupting chemicals",* presented at a workshop entitled "Endocrine disrupters and consumer products: Possible effects on human populations", Copenhagen, Denmark.

Shipp:

14. Resident presenter, "Arsenic Methylation and Genetic Polymorphisms in a bladder cancer study in Argentina," presented May 1, 2005 at: American College of Occupational and Environmental Medicine Conference, Washington DC, held from April 30-May 5, 2005.

Thundiyil:

15. Course faculty and speaker for *Hot Topics in Toxicology,* Oakland, CA, November 5, 2005. Hosted by University of California, San Francisco.

16. Grand Rounds Presenter. Chemical Terrorism. May 2006. John Muir Medical Center-Concord Campus.

17. Course faculty and speaker for Chemical Agents of Opportunity for Terrorism; "Terrorism by Fear and Uncertainty: Delayed Toxic Syndromes." San Francisco, CA, November, 2005; March 2006. Hosted by American College of Medical Toxicology/EPA/ATSDR.

18. Content Reviewer for WHO Training Package for the Health Sector. World Health Organization. "Children and Chemicals." July 2006. Created by Jenny Pronczuk, MD.

19. Thundiyil JG, Murphy NG, Tan J, Olson KR. "Scombroid Induced Myocardial Ischemia." Poster presented at North American Congress of Clinical Toxicology, Seattle, Washington September, 2004.

20. Thundiyil JG, Anderson IB, Stuart P, Olson KR. "Lamotrigine Induced Seizures." Poster presented at North American Congress of Clinical Toxicology, Seattle, Washington September, 2004.

21. Hayashi SA, **Thundiyil JG**, Flori H, Kearney TE. “Acute Iron Toxicity from Accidental Intravenous Administration of an Oral Iron Preparation.” Poster presented at North American Congress of Clinical Toxicology, Seattle, Washington September, 2004.

22. Thundiyil, JG, Kearney TE, Olson KR. “The Evolving Epidemiology of Drug-Induced Seizures Reported to a Poison Control System.” Poster presented at North American Congress of Clinical Toxicology, Seattle, Washington September, 2004.

23. Thundiyil, JG, Kalantri SP, Leeman E, et al. “Arsenic Poisoning in Bangladesh: a Public Health Disaster.” Poster presented at UC Berkeley Environmental Public Health Symposium, May 2005.

Gallagher:

24. Resident rounds, guest lecturer. An Approach to the Medical Literature, Kaiser Permanente, Oakland, 2007.

Morrow:

25. Rempel D, Scholssberg E, **Morrow S**, Llosa A, Dietrich P. Upper extremity pain and computer use patterns among engineering graduate students: An internet based study. PREMUS International Conference, 2004, Zurich.

26. Rempel D, Scholssberg E, **Morrow S**, Llosa A, Dietrich P. Musculoskeletal disorders and computer use among engineering graduate students: An internet based study. Human Computer Interface Conference 2005, Las Vegas.

Wang:

27. Lichty, P., Seabury, J., **Wang, C.**, et al. Laboratory Management, Draft Health and Safety Guidelines for Nanotechnology Research at the National Laboratories operated by the University of California , October 2004

Occupational and Environmental Health Nursing Program
University of California, San Francisco
Final Progress Report
July 1, 2002 - June 30, 2007

Abstract

The UCSF Occupational and Environmental Health Nursing (OEHN) Program in the Department of Community Health Systems (CHS) at the University of California, San Francisco, was initiated in 1979 to prepare clinical specialists in occupational health nursing at the master of science (MS) level. Since 1981, 220 MS students have graduated, for an average of 8.5 per year. During the last five year period, 39 MS students have graduated with role specialization as nurse practitioners, administrators or clinical nurse specialists in occupational and environmental health. In 2007, OEHN will introduce the 4 quarter specialist program to attract working OHNs to MS degree preparation. In 1986, NIOSH approved and extended funding for research trainees in the School of Nursing doctoral program who choose to focus on occupational and/or environmental health. To date, OEHN faculty have chaired or participated on the doctoral committees of 11 PhD graduates affiliated with the Program and 3 additional non-OEHN PhD graduates, and for an additional 8 current PhD students.

Dr. Julia Faucett (1994-2003, 2006-07) and Dr. Marion Gillen (2003-2006) have served as Program Directors over the last 5 years. Dr. Oisaeng Hong, formerly OHN Program Director for the University of Michigan, will be Director in 2007-08. Core and affiliated faculty currently include 7 doctorally prepared nurses and 2 clinical nursing faculty with expertise in occupational health and primary care. Program faculty have focused special attention on low wage workers in the garment, agricultural and construction industries in their research and clinical programs, as well as on health disparities and injuries among health care workers.

Highlights/Significant Results

Since 2002, 39 MS students have graduated from the OEHN Program, with nearly 1/3 of these from under-represented groups. More than half of the graduates are working at least part time in occupational health settings; two serve as academic faculty; others are considered experts in OEHN in their primary care or specialty practice settings. Two students graduated from the PhD Program in the last five years, and 8 were enrolled as of June 2007. Graduates in the last 5 years have focused their doctoral dissertations on back injuries among home care nurses and women's ergonomic working conditions. Additionally, 4 doctoral students have held National Occupational Research Agenda (NORA) fellowships over the funding period, contributing from their research activities to the national knowledge base about occupational hazards, illnesses and injuries. Seven students competed successfully to hold internships with the federal Occupational Health and Safety Administration as part of their graduate study. In addition to the NIOSH traineeships, students have competed successfully for funding from such sources as the AAOHN Foundation, American Lung Association, Sigma Theta Tau, PEO Society, and American Nurses' Foundation, among others. They have also received the ANA Nurse in Washington Internship, Lanctot Scholarship for Native Americans, Korean American Scholarship and the prestigious Betty Irene Moore Fellowship.

Outcomes/Relevance/Impact

A recent survey of graduates indicated that over 90% rated the program as very good to excellent. Additionally, recent peer reviewers cited the program as "mature and well-established," with "excellent leadership" and "excellent clinical resources for students." As result

of the OEHN educational program and training efforts, graduate nursing students have offered high quality nursing care and consultation to workers and employers in many industries, including manufacturing, pharmaceutical, biotechnology, and health care; presented at national and international symposia about their research and clinical work; and provided consultation and assistance with federal OSHA's nationwide projects and publications. Through their clinical placements, they have provided prevention program projects related to chemical safety, respiratory protection, ergonomics, food preparation hygiene, health promotion and other topics of import to workers and employers. Their work in these clinical rotations has reached at risk populations such as janitors, uninsured musicians, garment workers, welders, and nail salon operators as well as Korean American and other Asian, Hispanic, Black African American workers. Graduates of the Program have not only become advanced clinicians in this specialty area but have also advanced to leadership roles in professional associations (e.g. President of ANA, President of AOHP, AAOHN local and regional leadership) as well as roles as faculty, researchers, and policy development.

Faculty research has provided opportunities for MS and PhD students to gain experience with investigation methods and appreciate the emphasis of NIOSH R2P program. Dr. Gillen's research has led to considerably increased interest in the hazards of bloodborne pathogens and sharps injuries. Her work to evaluate regulatory efforts to reduce such injuries has direct impact on practical efforts to improve working conditions of health care personnel through regulation and also local effort to change practice. Dr. Faucett's research on farm workers and musculoskeletal disorders has long been recognized for its immediate applicability to the agriculture industry. As the lead health care researcher on the UC Agricultural Ergonomics Research Center team, her work has provided a key cornerstone for testing engineering, administrative and behavioral interventions in fruit, vegetable and horticulture commodities – leading to new tools and task practices that are disseminating throughout California and other agricultural industries. Additionally, Ms. Burgel's development of the Community Occupational Health Program and Ms. Segovia-Bain's work with Glide Health Services Clinic provided students with unique opportunities for worker outreach, education and clinical activities in the community.

Despite the considerable productivity of the OEHN program, the demand for OEHNs in California, especially those with formal graduate education in the specialty, continues to outstrip the supply. In fact, Program faculty receive several email notices weekly from employers and search firms seeking OEHNs. Furthermore, AAOHN continues to report that approximately 2% of its national membership hold masters or doctoral degrees, as compared to over 6% for nursing as a whole. The gap between the number of workers who need OEH services and the supply of registered nurses with specialty preparation to deliver these services remains wide.

Technical Report

Background. The UCSF Occupational and Environmental Health Nursing (OEHN) Program in the Department of Community Health Systems (CHS) was initiated in 1979 to prepare clinical specialists in occupational health nursing at the master of science (MS) level. Since 1981, 220 MS students have graduated, for an average of 8.5 per year. During the last five year period, 39 MS students have graduated with role specialization as nurse practitioners, administrators or clinical nurse specialists in occupational and environmental health. In 2007, OEHN will introduce the 4 quarter specialist program to attract working OHNs to MS degree preparation. In 1986, NIOSH approved and extended funding for research trainees in the School of Nursing doctoral program who choose to focus on occupational and/or environmental health. OEHN faculty have chaired or participated on the doctoral committees of 11 graduates affiliated with the Program

over its history and of an additional 8 continuing students within the last five year period. Dr. Julia Faucett (1994-2003, 2006-07) and Dr. Marion Gillen (2003-2006) have served as Program Directors over the last five years. Dr. Oisaeng Hong, formerly OHN Program Director for the University of Michigan, will be the most recent Director (2007-08). Core and affiliated nursing faculty in the program currently include seven doctorally prepared nurses and two clinical nursing faculty with expertise in occupational health or primary care.

From 2002-2007, UCSF offered students in the OEHN Program the MS degree with specialization as an adult nurse practitioner, nurse administrator or clinical nurse specialist. Requirements for graduation with the MS degree include OEHN core requirements, School of Nursing MS core requirements, and role preparation courses related to the student's choice of advanced nursing role (NP, administrator, CNS). The Program's core OEH curriculum focuses on the OEHN role; the assessment and control of toxicological, safety, ergonomic and other hazards; intervention in the form of injury control, clinical management, and program planning, implementation, and evaluation; and research, policy, and regulatory issues in occupational and environmental health. The School of Nursing MS core courses prepare advanced practice nurses for national and professional leadership and include content about health care economics and policy, research, theory and ethics in nursing and leadership skills. All MS students are also required to complete coursework in sociocultural diversity. OEHN students are also required to complete an introductory course in epidemiology. Faculty from the industrial hygiene, ergonomics and OEM programs teach in the program and offer guest lectures, as do OEHN experts from the community and industry. Students in the NP and CNS tracks are eligible to apply for State Board of Registered Nursing (BRN) NP and CNS role certification, national certification through American Nurses' Credentialing Commission (ANCC), and, after satisfying additional work time requirements, for the specialty certification offered through American Board of Occupational Health Nursing.

All OEHN MS students spend a minimum of 90 hours in a role residency, working with an OEHN preceptor in one of a variety of occupational health services and developing health and safety programs. A formal workplace community based needs assessment, organizational analysis, and executive summary are required. In the past, students have been placed at Intel, Hewlett Packard and Solectron (computer and chip manufacturers); Roche, Chiron and Genentech (biological engineering and pharmaceutical firms); Ghiradelli Chocolate and Schlage Lock (manufacturers); AT&T and Pacific Bell (telecommunications); Pacific Gas and Electric (public utility); Alta Bates, Camino Care and UCSF Medical Centers (hospital employee health clinics); and the State Compensation Insurance Fund (worker compensation insurance). In these settings, students work with multidisciplinary team members from safety, ergonomics, human resources, OEM and IH to develop their special projects. Throughout the curriculum, OEHN nursing faculty have focused attention on special populations of workers at risk, such as the immigrant Hispanic and Asian workers in agricultural, construction, garment making and manufacturing industries with which core nursing faculty interact in their clinical and research endeavors. Students were provided with hands on experience with low wage worker populations through experiences with COHP, the Glide Health Services, and the agricultural research projects.

The OEHN research training program occurs primarily at the doctoral level; however, MS students receive 5 units of research training through MS core courses. Doctoral research trainees are prepared to contribute to knowledge development in the field of occupational and environmental health, and to assume leadership positions in the profession. The emphasis of the OEHN doctoral program is on clinically relevant research. The training includes an initial 2 years of core courses in nursing science, biostatistics, and quantitative and qualitative research

design. Students also select one course about nursing theory, 2 cognate courses and 2 advanced nursing seminars that focus on key areas of nursing research interest. The OEHN doctoral seminar qualifies as an advanced nursing seminar. The seminar is required of NIOSH funded OEHN students and, in fact, all OEHN students attend every quarter. Students also participate in two research rotations for practical skill development. For their cognate coursework, they are encouraged to take courses in ergonomics, toxicology, occupational epidemiology and other electives offered by COEH affiliate programs or consortium universities (Stanford, SF State) as well as to take their research residencies with funded OEH researchers.

During the last five year period, the core faculty included experts with skills in occupational health clinical management (Blanc, Burgel, Jewell, Rempel, Segovia-Bain), primary care (Burgel, Kelber, Janson, Segovia-Bain), symptom management (Faucett, Janson, Lee, Segovia-Bain), work organization (Faucett), nursing research (Faucett, Gillen, Lee, Janson), epidemiology (Froelicher, White), and behavioral science (Faucett, Gillen, Janson). Faculty also offer expertise in industrial hygiene and safety (Quinlan, Plog), toxicology (Blanc, Jewell), ergonomics and musculoskeletal disorders (Burgel, Faucett, Rempel), pulmonary disorders (Blanc, Janson), infectious disease (Gillen, White), and occupational injury (Faucett, Gillen). The supporting or affiliated faculty also provide expertise and curricular support in the areas of occupational health (Balmes, Harrison, Israel, Souza), primary care (Saxe), and administration (Holzemer, Seago). Core nursing faculty provided opportunities for students to participate in research related to musculoskeletal disorders and job strain (Faucett) and sharps and other acute injuries (Gillen). Additional areas of OEHN student research are well supported by Drs. Janson (pulmonary disorders), White (infectious disease), Lee (sleep, circadian rhythms, women's health) and Froelicher (cardiovascular disease). With the addition of Dr. Hong, the Program will extend its expertise in the areas of hearing loss and international and global occupational health care

Objectives. The goal of the MS Program is to prepare advanced level occupational and environmental health nursing specialists and leaders with expertise in clinical practice and management, research and evaluation, and policy and program development. Graduates are prepared to identify health hazards in the work environment and propose appropriate control strategies; design, implement and evaluate health programs for the work setting; monitor and consult on legislative and regulatory changes pertinent to occupational health; identify research questions from OEHN practice; and develop the policies and procedures, professional and referral networks, and data-based systems that are central to OEH service activities. NP graduates are also able to diagnose and treat work related injuries and illnesses in collaboration with other core OEH disciplines. Nursing administration graduates are prepared to direct OEH services utilizing financial, workforce management and health policy skills. CNSs are prepared as advanced practice nurses with skills in program development and evaluation, disability management and worker training.

Results and discussion. The research training program has made notable contributions to the field of OEHN in terms of research productivity and the publications and presentations of its faculty and students. Their research focuses on (a) industries that have had insufficient attention from researchers, such as agriculture and construction; (b) vulnerable workers and their families who are at high risk for injury and illness, such as health care workers, working women and low wage immigrant workers; and (c) serious adverse affects of worksite and environmental conditions, such as back and traumatic injuries, asthma and TB. OEHN nurse researchers at UCSF bring broad perspectives to this work: systems expertise (work organization, health care delivery systems), social science expertise (health behaviors, risk perception, behavioral change), and knowledge of physiology and illness outcomes (musculoskeletal, pulmonary,

reproductive, cardiovascular). Students are acquiring not only practical research experience through their work with faculty, but also content knowledge in areas of importance for occupational and environmental health in the coming decades.

Program graduates have become University faculty and professional leaders. Over the course of the Program, they have achieved recognition as leaders in professional associations, expert clinicians and consultants, and promising researchers in such roles as current President of the American Nurses' Association, previous President of the Association of Occupational Professionals in Healthcare, California OSHA Advisory Committee member, AAOHN Nurse Intern in Washington, university faculty (four), corporate nurse consultants for California's State Fund (three), Federal OSHA Nurse interns (many) and active members of the Sigma Theta Tau nursing honor society (many). Ten of 11 winners of the UCSF Barbara A. Resnik Writing Award are published authors because of this annual award initiated in honor of the founding director of the program.

Conclusions. The UCSF OEHN Program has successfully maintained its record of high achievement over the last five year funding period, graduating clinical experts, leaders and researchers from its MS and PhD programs. Students and reviewers support the assessment that the faculty, curriculum and resources provide for an excellent program. Students and faculty have contributed to the knowledge base of the profession, and offer exceptional occupational health nursing expertise in key industries and occupations: health care, agriculture, garment work, and janitorial service, including foci on ergonomics and acute injury. Nonetheless, there continues to be a high demand in California for additional OHN professionals and the Program receives calls each week to place graduates in OHN clinical, faculty or leadership positions.

Publications Co-authored by Trainees

The following is a list of publications on which students or residents are authors. Student's names are in **bold** and faculty names are underlined.

1. Cheung K, Gillen M, Faucett J, Krause N. (2006). The prevalence of and risk factors for back pain among home care nursing personnel in Hong Kong. Am J Ind Med. 49(1):14-22.

2. Cheung K. (2004) UCSF, School of Nursing, dissertation defense: The Prevalence of and Risk Factors for Work-Related Back Problems Among Community Nursing Personnel in Hong Kong.

3. Foxman, I & Burgel, B.J. (2006). Musician health and safety: Preventing playing-related musculoskeletal disorders. AAOHN Journal, 54(7):309-16.

4. Hagan, K. (Unpublished Master's Thesis). Rates of Needlesticks in California Home Health Agencies 1997-2001. (Submitted, June 2006).

5. Landry, LG. (2006). Preventing occupational injuries: women's perception of risk from musculoskeletal exposures. AAOHN J. 54(2):75-83.

6. Landry, LG (2003) UCSF, School of Nursing, dissertation defense: Women's Perception, Safe Work Behavior, and Work-Related Musculoskeletal Injury

7. Janowitz, I., Gillen, M., Ryan, G., Rempel, D., Trupin, L., Swig, L., **Mullen, K.**, Rugulies, R., &, Blanc, P. (2006). Measuring the physical demands of work in hospital settings: Design and implementation of an ergonomics assessment. Applied Ergonomics, 37(5), 641-658.

8. Gillen, M., Yen, I., Trupin, L., Swig, L., Rugulies, R., **Mullen, K**., Font, A., Burian, D., Ryan, G., Janowitz, I., Quinlan, P., Frank, J., & Blanc, P. et al. (2007). "The association of socioeconomic status and psychosocial and physical workplace factors with musculoskeletal injury in hospital workers." *American Journal of Industrial Medicine*, (50) 245-260.

9. Pun, J.C., Burgel, B.J., Chan, J, and Lashuay, N. (2004). Education of Garment Workers: Prevention of Work-Related Musculoskeletal Disorders. AAOHN Journal,52(8): 338-343.

Industrial Hygiene Program
University of California, Berkeley
Final Progress Report
July 1, 2002 - June 30, 2007

Major Accomplishments and Changes

The Industrial Hygiene Program underwent a substantial revision over the five-year reporting period, in part due to an external review of the program (report dated February 2002), and in part due to a decline in student enrollment. Two problems cited in the external review were intertwined, namely, (i) the curriculum was excessively focused on traditional IH and did not relate to problems of the future, and (ii) there were too many required courses. A related problem with offering IH specialty courses was that there were too few students to justify offering full-semester courses. In response, the curriculum was revised. IH became a subspecialty in a broader Exposure Assessment and Control track in the EHS Division. Core material from three traditional IH lecture courses (Physical Agents, Engineering Controls, Applied Industrial Hygiene Problem-Solving) was combined into one course (Exposure Assessment and Control II), and material from two other full-semester classroom courses (Occupational Safety, Professional Practices) was conveyed in a more flexible, less time-consuming format.

Due to fewer required courses, students now take a greater number of elective courses related to occupational health, where the latter subject is broadly defined to include topics such as biological hazards, molecular epidemiology, ergonomics, business management, and social/cultural perspectives in public health. The full-semester EHS Division courses required for IH students include Exposure Assessment and Control I, Exposure Assessment and Control II, Risk Assessment, Toxicology, and Epidemiology. A two-day occupational safety short course with a follow up case fatality analysis, participation at an occupational medicine clinic, and a summer internship under the direction of a CIH, are also required for MPH IH students.

During this time, the program focused equally on practitioner-training (the MPH degree) and research-training (the MS and PhD degrees). We presently have three PhD students, two MS students, and five MPH students in the IH program. A third MS student is currently on leave of absence expecting to finish in 2008. Thus, half of the current IH students are obtaining research degrees. The number of PhD students (three) is reasonable given that the EHS Division is relatively small, and that most of the EHS Division faculty's research interests are outside the traditional IH arena.

The IH Program has not reapplied for ABET accreditation of the MPH degree program, which had been granted in 1996. The reason involves the goal of moving toward more research degrees (MS and PhD), and the faculty's judgment that ABET accreditation does not add academic value to our classroom and research training.

Of note, MPH IH students also had the opportunity to pursue research. In 2005, the MPH IH students participated in a research project at the New United Motors Manufacturing Incorporated car/truck assembly plant in Fremont, CA. They conducted air sampling for welding fume exposure, and estimated volumetric supply airflow rates, in the body weld department. This work was a follow up to a multidisciplinary project conducted in Years 2000 and 2001. In the original study, welding fume exposures and respiratory symptoms were determined for employees in the body weld department. The final study report recommended that ventilation be

improved to reduce welding fume exposure. The purpose of the 2005 study was to determine whether the ventilation improvements made by the company were effective in reducing those exposures. Professor S. Katharine Hammond directed both the follow up study and the industrial hygiene component of the original study.

All IH students had the opportunity to participate in one-year multidisciplinary projects with funding from the Center for Occupational and Environmental Health through the annual Student Award Program. In 2002, a MPH IH student helped conduct a study of pulmonary function among rural Guatemalan women exposed to cook-stove smoke in conjunction with an environmental health sciences PhD student. In 2003, a MPH IH student conducted an occupational exposure assessment for polybrominated diphenyl ethers in collaboration with a second MPH student in environmental health sciences. In 2005, a PhD IH student conducted a study of cement dust and noise exposures at a cement plant in Nicaragua, with assistance from an OEHN student from UCSF, and an MS student in the EHS department. Finally, in 2006, a PhD IH student mapped welding fume exposure in a manufacturing facility in China. A PhD OEHN student assisted with the development of a pulmonary health screening tool for this project.

In 2006-2007, Dr. Stephen Rappaport rejoined the EHS Division faculty as Adjunct Professor. Dr. Rappaport was just named the director of the new Berkeley Center for Exposure Biology, one of only a few centers awarded funding through the National Institute of Environmental Health Sciences. Dr. Rappaport will advise PhD IH students who want to work on developing and/or applying biomarkers of chemical exposure. He will also co-teach a course on Human Toxicology (currently in development) with Dr. Christine Skibola, Adjunct Associate Professor in the EHS Division. This course will present material on exposure biomarkers.

Research Training Program

Industrial hygiene research activity has primarily been under the direction of Dr. Hammond and Adjunct Professor and IH Program Director Mark Nicas. In addition, Dr. Martyn Smith has directed toxicological research with an occupational component. Dr. Hammond currently advises a PhD IH student whose project involves, in part, the mapping of welding fume concentrations at a manufacturing facility. Dr. Nicas currently advises two PhD IH students. One student in studying pathogen exposure and risk assessment, and is experimentally investigating the validity of a particle transport-and-fate model developed by Dr. Nicas. The second student is exploring the quantification of pesticide exposures. Dr. Nicas also advises a MS IH student who is investigating hand contact and droplet spray exposure routes for respiratory tract pathogens such as seasonal influenza virus.

Although research activity in exposure assessment as broadly defined has been extensive during the five-year period, a modest part has been in a traditional IH context. In fact, exposure assessment methods developed in the IH profession are now widely applied in the broader environmental health arena. An increasing number of non-IH EHS Division graduate students conduct exposure assessment and control studies. Professor Kirk Smith's work on the exposure of women and children to the products of biomass fuel combustion in homes in the developing world, Professor Hammond's work in assessing exposures to environmental tobacco smoke, and Professor Robert Spear's work on controlling exposures to waterborne parasites in China, are examples of the broadening application of techniques originally developed for the occupational environment. Viewed from this perspective, the research activity at Berkeley continues to be vigorous.

Supply and Demand for Graduates

Graduates from the master's and the doctoral programs in industrial hygiene have found jobs relatively easily. Most Master's graduates continue to remain in the Bay Area, where demand remains strong. Local employers are eager to work with students and graduates, as evidenced by the demand for more summer interns than we can supply each year, and the strong relationship with the Northern California section of the American Industrial Hygiene Association, which has an annual student night and presents awards to students.

Plans for the Future

The use of biomarkers in chemical exposure assessment will find increased use in epidemiology studies and in occupational settings in which exposure via dermal contact makes an important contribution to total absorbed dose. Drs. Stephen Rappaport and Martyn Smith direct the new Berkeley Center on Exposure Biology. We expect that some future PhD and MS IH students will pursue biomarker-related research via the new Center's research facilities and funding. In addition, interest in the IH program remains strong with nine students currently in training.

Publications Co-authored or Authored by Trainees

The following is a list of publications on which students or residents are authors. The students' and residents' names are in **bold** and core faculty names are underlined.

1. Nicas M and **RM Jones** (2007): Apportioning Influenza Infection Risk Across Exposure Pathways, submitted to *Risk Analysis*

2. Nicas M, W Nazaroff and **RM Jones** (2007): A Markov Chain Model for the Transport and Fate of Supermicron Particles in Indoor Air, submitted to *J. Occup. Environ. Hyg.*

3. Wilson MP, SK Hammond, M Nicas and A Hubbard (2006): Worker Exposure to Volatile Organic Compounds in the Vehicle Repair Industry, *J. Occup. Environ. Hyg.4*:301-310

4. Jones RM, M Nicas, A Hubbard and A Reingold (2006): The Infectious Dose of *Coxiella burnetii* (Q Fever), *Appl. Biosafety 11*:32-41

5. Jones RM and M Nicas (2006): Evaluation of COSHH Essentials for Vapor Degreasing and Bag Filling Operations, *Ann. Occup. Hyg. 50*:137-147

6. Jones RM and M Nicas (2006): Margins of Safety Provided by COSHH Essentials and the ILO Chemical Control Toolkit, *Ann. Occup. Hyg. 50*:149-156

7. Jones RM, M Nicas, A Hubbard, M Sylvester and A Reingold (2005): The Infectious Dose of *Francisella tularensis* (Tularemia), *Appl. Biosafety 10*:277-289

8. Nicas M, A Hubbard, **RM Jones** and A Reingold (2004): The Infectious Dose of Variola (Smallpox) Virus, *Appl. Biosafety 9*:118-127

Hazardous Substance Academic Training Program
University of California, Berkeley
Final Progress Report
July 1, 2002 - June 30, 2007

Highlights/Significant Results

The initial application for the Hazardous Substances Academic Training (HSAT) program was approved for a 3-year period starting in July, 2004. Its goal was to develop and implement a sound education program to train professional personnel to carry out responsibilities in hazardous substance response and site remediation as authorized by SARA, as well as fulfill their professional role in the broader area of hazardous substances. The academic training program was designed to prepare occupational safety and health professionals for practice, research and teaching with a specialization in hazardous substances through a combination of coursework, summer internship experience, and independent study.

The initial proposal contained the following action items for successful implementation of the HSAT program:

1. Support one or more students (depending on budget received).
2. Develop and present a new 3-credit graduate course in Hazardous Substance Management and Control (required of all Industrial Hygiene students). One goal of the course was to meet the OSHA Hazwoper “40 hour training” criteria.
3. Define “professional competencies” needed for a Hazardous Substances “technical specialist.”
4. Integrate Hazardous Substance-specific topics where appropriate in existing courses.
5. Perform a “Needs Assessment” for HSAT Program graduates.
6. Develop Hazardous Substance-focused summer internships.

Accomplishing this list of action items was predicated on receiving the requested level of funding. When this amount was not available, we prioritized our action items to concentrate on the most important items: 1- 3 were fully completed in the initial 3-year period. We also conducted a limited needs assessment (item 5) for the HSAT program, primarily with the California Department of Toxic Substance Control (DTSC), an agency of the California Environmental Protection Agency (Cal/EPA).

During the past 3 years, the HSAT program was administered as part of the overall Industrial Hygiene (IH) specialization within the Exposure Assessment and Control track. This permits total integration of the two programs and minimizes administrative costs. Dr. Mark Nicas is the IH Program Director and serves as Program Director for the HSAT Program. Other ERC staff provided the same support to the HSAT program as to the IH specialization program.

The HSAT Program development and execution is under the overall direction of Robert C. Spear, Ph.D., Professor of Environmental Health Sciences (IH), and the founding director of the Northern California ERC. Dr. Spear is a recognized expert in the overall field of hazardous substance recognition, evaluation and control. Dr. Nicas is a recognized expert in respiratory protection, industrial hygiene sampling strategy, and the physical-chemical mathematical modeling of exposure intensity.

Development and implementation of the HSAT Program was performed by Barbara Plog, MPH, CIH, CSP and Henry J. McDermott, CIH, CSP, PE, under Dr. Nicas' overall direction with direct involvement by the other IH faculty.

Student Trainee Support

The first HSAT trainee was accepted into the HSAT program in Fall Semester, 2005, and was supported for two academic years until graduation with an MPH degree. The second student was supported for the first MPH academic year starting in the fall semester of 2007. The first student completed a summer internship with Cal-OSHA, where he applied knowledge obtained in the HSAT-funded academic class as described below.

Students supported with HSAT funds were recruited and selected using the same process as for general IH specialization students. Those showing an interest in hazardous substance-related careers or research were identified as likely recipients of HSAT funding; final selection used a competitive review process to yield the strongest candidates. Ms. Norma Firestone is Student Affairs Coordinator for the Environmental Health Sciences Division; she manages admissions and conducts recruiting in addition to monitoring student progress, and tracking statistics about the program.

New emphasis was placed upon recruitment of students chosen into the IH specialization program (from which HSAT students will be picked). A recruitment committee was convened in May 2004 and met ten times to date. The committee consists of faculty of the HSAT program (Dr. Mark Nicas, Barbara Plog, and Hank McDermott) and also two current students (an MPH student and a PhD student), an alumnus of the program who is now Manager of EHS on the Berkeley campus, and also two administrative staff of the COEH. The committee produced a recruitment brochure which was distributed from the SPH Booth at various conferences, including at the American Industrial Hygiene Conference. It has also been posted and distributed to undergraduate students on the Berkeley campus. The brochure is being continually posted and circulated to undergraduate and graduate programs on the UC Berkeley campus, as well as in other arenas when applicable.

New 3-Credit Hazardous Substances Class

All students in the IH specialization were required to complete a new 3-credit course developed under the grant (PH 298-052: Hazardous Substances Management and Control) first presented in the Spring, 2006 semester that covered relevant information and issues in more detail than available in other courses. Dr. Nicas is the Faculty of Record for the class; the class material was developed and presented by Barbara Plog (Director of the ERC's Continuing Education program) and Henry J. McDermott (Adjunct Lecturer).

The class aimed at preparing students to fill the role of "Site Safety and Health Officer (or Supervisor)" as required by the OSHA Hazwoper regulation. This is the individual located on a hazardous waste site or spill site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements. To prepare students to fill this role, the specific class topics and materials were based on an outline of provisions in the Hazwoper standard (e.g., Risk Identification and Evaluation, Safety and Health Program, Chemical Hazards, Physical Hazards, Air Monitoring, Personal Protective Equipment, Medical Surveillance, Site-specific Safety and Health Plan, Safety and Health Training Program, Standard Operating Procedures for Safety and Health, Emergency/Spill Response) plus other topics to provide adequate

coverage of the field (e.g., hazardous substance management, “Best Practices Programs” in different industries, abandoned or orphan sites, and preventing future problems through proper management of Hazardous Substances).

The Hazwoper Standard (29 CFR 1910.120) was used in each class to set the context of the class material; class quizzes focused on Hazwoper requirements. Many of the class topics were chosen to integrate Hazardous Substances-specifics with material covered in other course. For example, one session built upon another course in exposure assessment to prepare students to conduct site assessments and personal exposure monitoring required at and appropriate for a hazardous waste or uncontrolled release site. Similarly, whereas other academic courses dealt with respiratory protection and personal protective equipment, this class focused on use of these devices at hazardous waste and release sites. Each student completed a respirator medical evaluation and quantitative fit testing, both to prepare them to work at a site and also so they would have the knowledge to administer and evaluate hazardous waste site PPE programs for compliance and effectiveness. The class visited a site remediation underway at a former munitions plant located adjacent to the San Francisco Bay to experience the field aspects of a remediation project. As part of the class, each student completed “40 Hour OSHA Hazwoper Training” and also completed the on-line FEMA Independent Study Program “IS-100: Introduction to Incident Command System.”

In the didactic portion of the class, basic material was presented by an instructor (Plog or McDermott) supplemented with “seminar” presentations by noted outside speakers. Before and after each seminar speaker, Ms. Plog or Mr. McDermott placed the speaker’s topic in context relating to OSHA Hazwoper, CERCLA, RCRA or other areas related to hazardous substances. Outside speakers and their topics included the following:

- State Designation/Regulation of Hazardous Waste Sites: B. Cook, PE (Cal. DTSC)
- Protecting the Public Health from Hazardous Materials: W. Brunner, MD, MPH (County Pub Hlth Dir.)
- Hazardous Substance Management in a High-Tech Environment: B. Sherin, CSP
- Electrical Hazards and Controls: K. Gershon, PE (LLNL)
- Noise: Measurement & Control: C. Kirkham, MPH, CIH (Cal-OSHA)
- Medical Surveillance and Case Studies: R. Harrison, MD, MPH (UCSF)
- Respiratory Protection, PPE Ensembles: P. Quinlan, MPH, CIH (UCSF)
- Respirator fit-testing: S. Jacuzzi and R. Waller (UC Campus EH&S)
- UC Berkeley’s Hazardous Materials Management Program: H. Randol (UC)
- Port of Oakland Hazardous Substances Program: J. Jones, MS, CIH
- UC Berkeley’s RFS (Old Munitions Plant) site remediation: Karl Hans (UC)
- Emergency Spill Response: G. Hunting, CIH, CSP (Chevron Corporation)
- Preventing Future Problems – Prudent Practice and Due Diligence: C. Laszcz-Davis, CIH

The 3-credit graduate class was co-offered by COEH as a continuing education seminar series for practicing industrial hygienists, safety and environmental specialists. Typically 10-15 local professionals attended each class, which resulted in a richer discussion and more exposure to real world challenges than would occur in a purely academic class. This benefited the IH students as well.

Both students supported in the HSAT Program completed this required class. The first student, who graduated in spring, 2007, (and all students who attended the class and became

HAZWOPER certified) was offered a one-year refresher class in spring, 2007. This class was given by the COEH's Labor Occupational Health Program (LOHP) and thus allowed the 2007 graduates to graduate while maintaining their HAZWOPER certifications.

"Competencies" for a Hazardous Substances Technical Specialist

Professional Competencies are a listing of the skills that a graduate should possess to be prepared for an entry level professional technical position. This approach is used at UC-Berkeley as an informal guide for students in planning their academic experience. It allows the students flexibility in using their summer internship, independent study, and prior experience as well as course work to prepare for their career.

These "Competencies" (in addition to those for an Industrial Hygienist) were identified as applicable for an entry-level Hazardous Substances technical specialist:

- Understand the key provisions of the relevant laws and regulations: CERCLA, RCRA, OSHA Hazwoper, and the California state counterparts.
- Understand the role and responsibilities of a Safety and Health Officer or Supervisor at a site that falls under the OSHA Hazwoper standard.
- Understand resources available from agencies such as NIOSH and ATSDR.
- Understand key provisions of some major regulations that apply at hazardous waste and spill sites in addition to the Hazwoper Standard (e.g., Hazard Communication, Benzene, Hearing Conservation, Respiratory Protection, and Confined Spaces).
- Ability to perform a site assessment and air monitoring to meets Hazwoper requirements: initial entry, direct reading instruments, periodic monitoring plan, and IDLH environments.
- Ability to prepare a site-specific Safety and Health Plan.
- Familiarity with typical physical hazards at sites: heat stress, noise and electrical hazards.
- Familiarity with common ergonomic hazards (and controls) at hazardous waste and spill sites.
- Familiarity with personal protective equipment ensembles (chemical protective gloves and garments, respiratory protection) used at hazardous waste and spill sites, and their limitations.
- Ability to conduct an inspection of a hazardous waste or spill site for general conformance to standards; make risk-based recommendations, if appropriate, to correct items that do not conform; identify other safety or health issues; and, prepare a report to the site manager or incident commander.
- Ability to fill the role of "Safety Officer" during spill response in the Incident Command System

Informal "Needs Assessment"

As stated earlier, a full needs assessment could not be accomplished due to insufficient funds. Instead, an informal needs review was conducted with selected agency contacts (primarily California DTSC) which demonstrated the critical need in California and nearby states for properly trained health and safety professionals and related Hazardous Substance professional specialists.

The DTSC, part of Cal/EPA, is the lead state agency over hazardous waste sites and most other environmental hazardous substances issues. The State Water Board has jurisdiction over

the >10,000 leaking underground storage tanks, while the Office of Spill Prevention and Response within the California Department of Fish and Game is the lead state agency charged with oil spill prevention and response for the state's marine environment. Cal-OSHA has jurisdiction over hazardous substances exposure and control in private and public workplaces. These agencies administer state programs, and also federal programs under agreement with the corresponding federal agencies (U.S. EPA, federal OSHA, U.S. Coast Guard, etc.). In many cases, the state agencies delegate responsibility for programs to regional or local agencies such as county health departments. In each of these agencies, there is the need for technical specialists knowledgeable in hazardous substances issues – the knowledge gained through academic programs such as the HSAT-sponsored traineeship and class.

As an example of the scope and extent of hazardous substances challenges, the DTSC's database lists 516 hazardous waste sites at some phase of assessment, remediation and closure process. California also has an active "Brownfields" initiative, which aims at returning contaminated sites to productive use as quickly as possible. DTSC specialists are involved at every step of the expedited process to ensure that the clean-up is adequate. There are 23 closed military bases in California, many with significant environmental contamination from past uses such as unlined disposal sites, plating shops, degreasing operations, PCB transformer storage areas, leaking fuel lines and storage tanks, industrial waste treatment plants, lead and asbestos. Clean-up of these sites is administered by the DTSC under agreement with the Department of Defense; about $18 million is spent annually on this effort.

A more recent challenge is the proper clean-up of clandestine drug labs ("Meth" labs). Under recent state legislation, DTSC, the California Department of Justice and local agencies will have a greater role in determining final clean-up standards and monitoring clean-up operations for adequacy. There is a defined role for industrial hygienists in these new state programs.

A subset of the 516 DTSC-regulated hazardous waste sites are those on U.S. EPA's National Priorities List (NPL), which represent the most serious threats nationwide. Based on the most current data, 96 of the 1,230 EPA NPL sites (≅ 8%) are in California; 32 are in the nine-county Bay Area. In addition to these legacy hazards, existing manufacturing and other industries in Northern California continue to generate hazardous waste, which poses a potential threat to those who routinely handle and transport the waste, as well as to emergency response personnel in cases of accidents, spills and fires.

From this information it is clear that there are both a large number of hazardous waste sites in California, and also many industries (as well as illegal activities) that continue to generate hazardous waste. Thus the potential for harm to the environment is great, as is the need for trained professionals to conduct and supervise feasibility studies, site investigations and site cleanup and respond to hazardous materials incidents and spills. Also these professionals must be trained in protecting the health and lives of those engaged in these activities, since these persons are at risk due to the nature of their work.

Recognizing that <u>prevention</u> is critical to avoiding future hazardous materials problems, the California DTSC and other agencies have comprehensive hazardous materials regulations that cover facilities and transporters handling hazardous materials within their jurisdiction. Typical components of programs to meet these regulations include hazardous material identification and inventories; public reporting; handling and release prevention procedures; community awareness; and preplanning with local emergency response agencies. Establishing and carrying out these programs require that industrial hygiene and EAC professionals employed by private firms and the agencies have a skill set that is broader than "traditional" IH practice, which

was focused on worker protection. This trend is part of the overall expansion in the role of industrial hygienists to now encompass selected environmental responsibilities including hazardous materials.

The need for trained professional and other personnel is also reflected in the continuing demand for hazardous waste training courses performed under the Hazardous Substances Training (HST) Program, and input from the HST Advisory Committee, as described under the "Hazardous Substance Training" program report. Additionally, informal feedback from recent IH/EAC MPH graduates supports the need for the Hazardous Substances Academic Training (HSAT) program in that they report that their jobs tend to include hazardous materials management and related topics as well as strict occupational health. It should be noted that IH MPH graduates have successfully found professional positions with both government agencies and the private sector; the HSAT program serves to enhance their contribution to both public and private sectors in protecting people and the environment.

Outcomes/Relevance/Impact

The most tangible impact of the program during the three years of its funding were threefold: student support, targeted internship work in the hazardous substances area, and graduates who were HAZWOPER certified upon graduation.

As stated above, two students received support during the three years of the HSAT program. One received support for a full two years during his MPH program. The second student is receiving support for the first (2007-08) year of her MPH program.

Second, targeted internships were developed through students taking the new HSAT funded course, (Hazardous Substances Management and Control). The practical payout for the students was evident during their summer internships or initial careers. The following summaries of internship projects demonstrate the effectiveness and usefulness of the HSAT program:

- One student, who was supported under the HSAT grant, had an internship with Cal-OSHA. He used the respirator quantitative fit test knowledge and understanding of the OSHA respirator standard requirements that he gained during the class to perform fit testing on Cal-OSHA compliance officers. Key to his success was knowing how to perform the tests using the Portacount device, which was taught in the class. He also participated in an unannounced compliance inspection at the Port of Oakland. Material covered in the class about industrial activities at locations such as ports aided him in this inspection. Having the "40 Hour Hazwoper" certification made him a more valuable employee for Cal-OSHA during these inspections.
- A first year MPH candidate, used the site assessment training information from the class to evaluate organic vapors at a gasoline service station site using direct reading instruments such as a Photoionization detector. He also evaluated confined space hazards.
- An MPH graduate now works for a local consulting firm. He is serving as on-site Health, Safety and Environment staff for a start-up company that has numerous hazardous substances issues. He is using class information to help with regulatory, monitoring and program implementation work.

Finally, an important outcome of the HSAT Program was students earning their MPH degrees with the important "value added" of HAZWOPER certification. This allowed them to fully

participate in valuable work during their internships. It allowed them to graduate ready and certified to perform the duties under the HAZWOPER standard. This was the first group of MPH students to graduate the Berkeley program with these certifications in place.

Future Plans

Due to the discontinuation of funding for the HSAT program, there are no current plans to continue this training program.

Ergonomics Training Program
University of California, San Francisco and Berkeley
Final Progress Report
July 1, 2002 – June 30, 2007

Highlights/Significant Results

During this 5 year period, the Ergonomics Graduate Training Program graduated 4 students with a M.S. degree and 9 students with a Ph.D. degree. Several of the students received independent research grants during this time. At the end of this time period, most of the students have stayed in the occupational health field and have gone on to consultancies or taken positions in industry, or transitioned to junior faculty positions, post-doctoral fellowships, or doctoral training programs. The research focus of the program is on epidemiologic and basic science studies that primarily address causes and prevention of upper extremity musculoskeletal disorders. However, several students have conducted or are conducting research in other areas such as low back injury, vision and neck problems. There were many scientific publications during these 5 years. Students were first authors of 33 peer-reviewed scientific journal articles or book chapters.

Outcomes/Relevance/Impact

Some of the key outcomes are summarized above. Students completed research on projects that were directly relevant to NORA priority areas and ranged from basic science mechanisms of injury of musculoskeletal disorders to the design and evaluations of workplace interventions to prevent injuries. The basic science studies identified, for the first time, a relationship between repetitive loading and microtears in tendon. These studies also found that force, rather than repetition rate was a greater contributor to tendon injury with repetitive loading. These findings suggest that our efforts at workplace intervention to prevent upper limb injuries be directed at reducing forceful loading associated with pinching or gripping.

Other students built on this information by designing and evaluating changes to tools to reduce pinch force. One student, the first dentist to receive a PhD in ergonomics, found that the diameter and weight of the most common tool used by dental hygienists to clean teeth, has a strong effect on pinch force. A larger diameter (up to 11 mm), lighter tool, can reduce pinch force by up to 35%. Hand and arm disorders are the most common cause of early retirement among dentists and dental hygienists.

Other students conducted research on the design of pipettors used in laboratories, arm supports for hand intensive jobs, and chair designs for garment workers. The interdisciplinary and intercampus bridges have strengthened the research training. Students with backgrounds in engineering work side-by-side and exchange knowledge and experience with students whose strengths are in biology and health.

Technical Report

California is the only state in the country with a workplace ergonomics standard and this graduate training program is the only program in California and the surrounding states to provide an M.S. and Ph.D. degree with training in Ergonomics. Students come to the program from a variety of backgrounds, such as engineering and biology. Trainees receive their degree from UC Berkeley's School of Public Health (Department of Environmental Health Sciences) or the UC Berkeley College of Engineering (Department of Mechanical Engineering or

Bioengineering). The Program is small but the quality of its graduates is high as demonstrated by their rapid employment by regional firms and agencies or advancement to Ph.D. training programs. Five of the Program graduates have filled faculty positions in ergonomics at other universities. Trainees usually have multiple job offers as consultants or as health and safety employees at companies or agencies.

As a small program, the courses, lectures and research advising are built by forming collaborative relationships with faculty from other disciplines. For example, students are required to take courses from the Departments of Industrial Engineering and Integrative Biology, and across the Bay at the UC San Francisco School of Nursing. Students from bioengineering, nursing, industrial hygiene and occupational medicine take the Ergonomics course (PH269C) side-by-side with ergonomics students.

The Ergonomics Program continues to provide training to health and safety professionals throughout the State via continuing education programs with COEH CE. A two day course is taught every August and December and is very popular, with attendance ranging from 70 to 150 regional professionals. In addition, a new three day course in Advanced Office Ergonomics was developed in 2003 and has been taught at four locations in California. These events are used as recruitment opportunities whenever possible. However, the high level of training and experience of ergonomists without M.S. training in California has prevented many from applying for graduate study.

The external review of the Ergonomics Program 2 years ago was very positive. The primary weakness identified was the need for an additional faculty in the area of ergonomics and safety at UC Berkeley to support the training program. The Director of the ERC recognizes this limitation and supports a hire in this area at the next opportunity for expansion. In addition, a possible weakness of training time on experimental design was identified. In order to improve training in the area of experimental design all trainees were required to take Ergonomics Seminar (PH 295, 1 unit) which meets continuously in Fall and Spring. This seminar focuses on experimental design by reviewing recent studies published in the literature and having students present and discuss research proposals. Occupational Biomechanics (PH 269D) is taught every-other-year and is required of all trainees. PH269D focuses on experimental and quantitative methods in research.

Publications Co-authored or Authored by Trainees

The following is a list of publications on which students or residents are authors. The students' and residents' names are in **bold** and core faculty names are underlined.

1. Schlossberg E, Morrow S, Llosa A, Mamary E, Dietrich P, Rempel D: [2004] Upper extremity pain and computer use among engineering graduate students. Am J Ind Med 46:297-303

2. Asundi K, Bach J, Rempel D: [2005] Thumb force and muscle load are influenced by pipetting tasks and pipette design. Human Factors 47(1):67-76

3. Conlon CF and Rempel DM: [2005] Upper extremity mononeuropathy among engineers. J Occup Environ Med 47:1276-1284

4. Dong H, Barr A, Loomer P, Rempel D: [2005] The effects of finger rest positions on hand muscle load and pinch force in simulated dental hygiene work. J Dent Educ 69(4):453-460

5. Kursa K, Diao E, Latanza L, Rempel D: [2005] In vivo forces generated by finger flexor muscles do not depend on the rate of fingertip loading during an isometric task. J Biomechanics 38:2288-2293

6. Nakama L, **King K**, Abrahamsson SO, Rempel D: [2005] Evidence of tendon microtears due to cyclical loading in an *in vivo* tendinopathy model. J Orthop Res 23(5):1199-1205

7. Dong H, Barr A, Loomer P, **Laroche C**, Young E, Rempel D: [2006] The effects of periodontal instrument handle design on hand muscle load and pinch force. J Am Dental Assoc 137(8):1123-1130

8. Kursa K, Latanza L, Diao E, Rempel D: [2006] In vivo forces generated by finger flexor muscles increase with finger and wrist flexion during active finger flexion and extension. J Orthop Res 24(4):763-769

9. Nakama L, King KB, Abrahamsson SO, Rempel DM: [2006] VEGF, VEGFR-1 and CTGF cell densities in tendon are increased with cyclical loading: An *in vivo* tendinopathy model. J Orthop Res 24(3):393-400

10. Winters J, Rempel D, **Story M**, Lemke M, Barr A, Campbell S, Danturthi S: [2006] The mobile usability lab tool for accessibility analysis of medical devices: design strategy and use experiences. In Medical Instrumentation: Accessibility and Usability Considerations, (eds. J Winters, M Story), CRC Press.

11. Asundi KR and Rempel DM: [2007] Cyclic loading inhibits expression of MMP-3 but not MMP-1 in an *in vitro* rabbit flexor tendon model. Clinical Biomech, in press

12. Asundi, KR, King KB, Rempel, DM: [2007] Evaluation of gene expression through qRT-PCR in cyclically loaded tendons: an *in vivo* model. Eur J Appl Physiol, in press

13. Asundi, KR, Kursa K, Lotz J, Rempel DM: [2007] *In vitro* system for applying connective tissues under displacement or force control. Annals Biomed Eng 35(7):1188-1195

14. Conlon CF, Rempel DM, Krause N: [2007] A randomized controlled trial evaluating an alternative mouse and forearm support on upper body discomfort and musculoskeletal disorders among engineers. Occup Environ Med, in press

15. Dong H, Loomer P, Villanueva A, Rempel D: [2007] Pinch forces and instrument tip forces during periodontal scaling. J Periodontology 78(1):97-103.

16. Dong H, Loomer P, Barr A, **Laroche C**, Young E, Rempel D: [2007] The effects of tool handle shape on hand muscle load and pinch force in a simulated dental scaling task. Appl Ergonomics 38:525-531

17. Laroche C, Barr A, **Dong H**, Rempel D: [2007] Effect of dental tool surface texture and material on static friction with a wet gloved fingertip. J Biomechanics 40:697-701

18. Nakama L, King KB, Abrahamsson SO, Rempel DM: [2007] The effect of repetition rate on the formation of microtears in tendon in an *in vivo* cyclical loading model. J Orthop Res 25:1176-1184

19. Nikanjam M, Kursa K, Lehman S, Rempel D: [2007] Finger flexor motor control patterns during active flexion: an *in vivo* tendon force study. Human Movement Science 26:1-10

20. Odell D, Barr A, Goldberg R, Chung J, Rempel D: [2007] Evaluation of a dynamic arm support for seated and standing tasks: a laboratory study of electromyography and subjective feedback. Ergonomics 50(4):520-535

21. Rempel D, **Wang PC**, Janowitz I, Harrison R, Yu F, Ritz B: [2007] A randomized controlled trial evaluating the effects of new task chairs on shoulder and neck pain among sewing operators: the Los Angeles garment study. Spine 32(9);931-938.

22. Rogers MS, Barr AB, Kasemsontitum B, Rempel DM: [2007] The development and validation of a 3D model of the hand. Ergonomics, in press

23. Wang PC, Rempel DM, Harrison RJ, Chan J, Ritz BR: [2007] Work-organizational and personal factors associated with upper body musculoskeletal disorders among sewing machine operators. Occup Environ Med, in press

24. Villanueva A, Dong H, Rempel D: [2007] A biomechanical analysis of applied pinch force during periodontal scaling. J Biomechanics 40:1910-1915

Continuing Education Final Progress Report
University of California, Berkeley
Final Progress Report
September 1, 2002 - June 30, 2007

Highlights/Significant Results

The 2002-2007 NIOSH reporting period was a very successful one for the COEH Continuing Education (CE) Program. The program offered 177 continuing education courses and trained 9,027 professionals, not including those trained under the separate Hazardous Substances Training (HST) grant and mentioned in the separate HST Final Progress Report. This number included 2,451 physicians, 744 nurses, 1,333 industrial hygienists and 914 safety professionals. The 3,574 trainees from other professions or for whom information was not available included asbestos and lead abatement contractors, physical and occupational therapists, professional ergonomists, consultants, scientists and agricultural employees.

Each COEH academic program developed at least one course per year for the annual Summer Institute. The Nursing Program provided the course director and development each year for "Workers' Compensation Overview Update." The Occupational Medicine Program provided a course director and development for "Occupational and Environmental Toxicology for the OSH Professional" every other year and for "Advances in the Diagnosis and Treatment of Work-Related Disabilities," a course for Qualified Medical Evaluators. The Ergonomics Program provided the course director and a new ergonomics class development each year. These included two special topics: "Stooped Postures in the Workplace," a 2004 class on agricultural ergonomics, and "Ergonomics in Workstation and Facility Design" in 2006.

The Summer Institute continued to provide the opportunity to offer a wider variety of new and timely, but sometimes financially riskier, courses to California occupational safety and health professionals as well as our regular classes, such as "Comprehensive Review of Industrial Hygiene," "Fundamentals of Industrial Hygiene," "Fundamentals of Workplace Safety," and "Respiratory Protection." Titles of new courses included "Emerging Infectious Diseases: What OSH Professionals Need to Know," "Molds: Health Effects and Exposure Assessment," "Hot Topics for the Busy IH and Safety Professional," "Applied Industrial Ventilation," and "Current Issues in Medical Monitoring."

The CE Program also continued its highly successful ergonomics courses jointly sponsored with the University of Michigan each December. The program offered all new speakers and topics each year and routinely attracted around 100 participants, including a loyal following that attended every year.

The COEH Symposium is a Center-wide event that was offered three times during the reporting period in Northern California. The Symposium features faculty and student research and the agenda often includes national and international guest speakers. At these events, student research is showcased in poster sessions, particularly multidisciplinary research and COEH student award projects. The COEH Symposium topics were as following: "Integrating Policy, Not Transferring Risk," (2003); "Promoting Primary Prevention in the California Workers' Compensation System," (2004); and "Occupational and Environmental Health in the Developing World," (2005). COEH faculty including Michael Wilson, Marion Gillen, John Balmes, and Kirk Smith were instrumental in developing these symposia.

The CE Program continued to offer the popular “Industrial Hygiene Forum Series” in collaboration with the Northern California Section of the American Industrial Hygiene Association (AIHA). Three low-cost short sessions each year presented topics of interest to local industrial hygienists and other health and safety professionals and continued to appeal to professionals with limited time and/or training budgets. Topics during the five-year period included ”Bay Area Air Quality Regulations and IH Practice,” “Occupational Health Regulations,” “Medical Monitoring,” “Confined Space Rescue,” “Control Banding,” Risk and Crisis Communication,” Emergency Preparedness and Recovery,” “OSHA Health Regulations and Legislative Update,” and “Pandemic Flu: Are You Ready?”

In the 2006-2007 reporting year, the CE Program offered two courses specifically designed for nurses. A one-day conference on “Preventing Sharps Injuries in California,” jointly sponsored with the California Department of Health Services, was held in September 2006 and attracted 94 nurses and other health professionals. In May 2007 the Occupational Health Nursing Program and the CE Program sponsored an occupational health nursing series of four short sessions entitled “Management of Clinical Occupational Health Problems” at UCSF. Thirteen occupational health nurses joined UCSF OEHN students in this series.

In Fall 2005, the CE Program assumed responsibility for the UC Berkeley Asbestos and Lead Paint Training Program during this reporting period, beginning in Fall 2005. This is the leading training program for asbestos and lead abatement professionals in Northern California. Through this program, the COEH CE program trained 873 professionals in 2005-2006, and 991 in 2006-2007. AHERA Initial and refresher courses are offered in three Asbestos disciplines: Building Inspector/Management Planner, Contractor Supervisor and Project Designer. Initial Lead courses are offered in Inspector/Assessor and Supervisor/Project Monitor. General Continuing Education Lead Refresher courses are also offered. These cover both Inspector/Management Planner and Supervisor/Project Monitor disciplines.

Outcomes/Relevance/Impact

The COEH CE Program is the premier continuing professional education program in Northern California offering high quality training to occupational health and safety professionals. It is widely recognized as “the” source of state-of-the-art professional training.

Course development always starts with awareness of the latest national and state occupational health and safety issues of which OSH professionals need to be aware. Our courses are accredited by the American Board of Industrial Hygiene, the Board of Certified Safety Professionals, the California Medical Association Institute for Medical Quality, the California Board of Registered Nursing, California OSHA (Asbestos training) and the California Department of Public Health (Lead training). COEH works closely with partners such as professional health and safety associations, state, city and county agencies and others throughout Region IX.

The CE Program polls its trainees on the type of training they need and the topics they are interested in through needs assessment forms. A needs assessment form was posted on the CE website during this period.

The CE Program conducted impact assessment surveys three months after all classes receiving CME credit. The responses showed that a good percentage of attendees received new information that they had taken back to their workplace and used themselves or shared with

colleagues. Starting with the July 2007 Summer Institute, CE trainees in all courses will receive an email impact assessment survey three months after taking the course.

Our courses routinely received very good or excellent evaluations from participants. The CE Program has many loyal trainees who come back again and again for the quality training they know they will receive from COEH. Over 1000 trainees in the CE database have taken 2 or more classes. Four hundred trainees have taken 5 or more classes.

Future Plans

The Northern California ERC program will continue to provide high-quality CE programs to a diverse audiences combining traditional courses with newly developed offerings. The CE program will also continue to develop distance learning programs as needed and when financially feasible, as well as continue to solicit impact assessment feedback from professionals. The CE program staff meet annually with the CE Program Advisory Committee as well as with the Labor Advisory Committee for feedback on the content and quality of the CE programs. Please see attached list of Advisory Committee members.

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Hazardous Substance Training Program Final Progress Report
University of California, Berkeley
Final Progress Report
July 1, 2002 - June 30, 2007

Highlights/Significant Results

The five year grant period from 2002-2007 was very successful for the COEH Hazardous Substance Training (HST) Program. The HST Program has experienced 18 years of growth and development bringing specialized training to increasing numbers throughout every state in the region, California, Nevada, Arizona and Hawaii. The HST Program is an innovative and widely known and respected regional training program which is sought out by target groups throughout the region. The Program receives yearly requests from a variety of groups including state hazardous materials conferences, the Environmental Protection Agency, state and county organizations, rural and community clinic organizations and Native American tribal agencies. Trainees, often covered by scholarships, represent minority and underserved populations (Hispanic and Native American) in addition to targeting state, county, municipal and federal government health and safety professionals. While the average number of trainees was 50 per year during the early years from 1988-94, in the past five years, the number of trainees totaled 1,264 (in 50 classes) for a five-year average of approximately 250 trainees per year. That figure represents a 400% increase from the early grant years

The HST Program has focused on two primary objectives: 1) it identifies and trains professionals throughout Region 9 who are involved in site investigation, site mitigation, hazardous substance handling and facilities management at waste sites contaminated by pesticides and wood preservatives, particularly those working in the public sector; and 2) it supports, through scholarship assistance, general hazardous waste training for other public sector professionals in Region 9 who could not otherwise afford the training they need.

Recruitment of Underserved Populations

Another aspect of the HST Program's target audience involves working with the underserved population of Native Americans throughout the region. The program has consistently trained tribal members from Arizona, Nevada and California, and is recognized and respected for its training by a number of tribal groups such as the Inter Tribal Council of Arizona. Scholarships are provided for all of these trainings.

During this past 5 year grant cycle, a wealth of specialized curricula were developed and presented as a result of ongoing needs assessments in all of the target states. The following list summarizes these specialty courses:

Pesticide Emergency Response – one day class aimed at firefighters, emergency medical technicians, hazardous materials specialists, pesticide applicators and others. This class has been given in two states (California and Nevada) hazardous materials conferences a total of four times during the 5-year grant period.

Hazards of Pesticides to Emergency Responders – a new half-day class aimed at firefighters, emergency medical technicians, hazardous materials specialists, pesticide applicators and others. This class has been presented 23 times in Nevada, southern and northern California, and Hawaii. This class marks a novel approach to training this audience as

it was offered to numerous "shifts" of firefighters in a location. In what we term "on-site, all shift training," in northern California, six shifts of firefighters were trained at two separate fire stations. In southern California, three shifts were trained at a fire department training site and in Hawaii, three shifts were trained. The Hawaii class in Honolulu was cosponsored by the Hawaii Department of Agriculture and trained 115 firefighters. The class was given four separate times over a two-day period and covered 4 shifts of firefighters.

Pesticides Injuries and Illness Workshop – a one-day class aimed at nurses and physicians at primary care and rural and immigrant health clinics and others. This class has been taught for Native American tribes on reservations, community health clinic settings in rural areas and elsewhere. It was presented six times in California and Arizona.

Pesticide Health Issues – a new one day class given in Arizona once in English and once in Spanish and cosponsored by the Inter Tribal Council of Arizona and the Arizona Department of Agriculture. This class targeted tribal and state government health care providers and professionals, emergency response personnel and health educators. Agricultural professionals, pesticide applicators and tribal and state pesticide program inspectors, environmental staff and industrial hygienists were also targeted. This class was presented twice in Arizona.

Asbestos Health Hazard Awareness Field Seminar – a half day class created for the California Integrated Waste Management Board given in California.

Pesticide Health Hazard Awareness Field Seminar – a half day class created for the California Integrated Waste Management Board given in California.

Hazardous Substances: Management and Control Seminar Series – created as a joint UC Berkeley course and an open-enrollment HST course, this class ran for 13 weeks. It is designed to award HAZWOPER certificates to UC Berkeley HSAT trainees. This series was highly successful and well-evaluated and offered IH students and the professional community the unique opportunity to interact in a seminar. The class included a field trip to a site undergoing active remediation.

Distance Learning Initiatives – In a very important and exciting development for the HST Program in the area of distance learning, two new online and web training courses have been developed and are in different project stages of implementation.

> ***1. Recognition, Management, and Reporting of Pesticide Illness –*** offers Continuing Medical Education and Board of Registered Nursing credit and is already approved by the CE/HST Program's CME Committee for an initial 3 year period. This web training program is jointly sponsored with the California Department of Pesticide Regulation Worker Health and Safety Branch and the California Office of Health Hazard Assessment, Pesticide Epidemiology Section. During the 2006-07 training period, 67 physicians, nurses and other health and safety personnel completed the online course.

2. Pesticide Illness – is a 6-8 hour CD-based training in 4 parts that uses PowerPoint presentations and speaker notes. This has been created in co-sponsorship with the California Department of Public Health. This project is in the early stages of development. Although the training CD has been produced and approved for medical and nursing credit, details for distribution and advertising are being finalized.

Program Evaluation

Improvements in the overall program evaluation process have also been made. First, the HST Regional Advisory Committee (See attached list for a roster of Advisory Committee members) has been asked to add an ongoing program evaluation agenda item to its list for ongoing discussion. This past year the HST Program instituted annual conference call meetings of the entire advisory committee. Previously, members from each state were consulted with on a state by state basis. This fall the item of strategic program planning was on the agenda for the fall 2006 meeting. Again in fall, 2007, that will be a standing agenda item.

Previously, the Program conducted impact assessment surveys three months after all classes receiving CME credit. The responses showed that a good percentage of attendees received new information that they had taken back to their workplace and used themselves or shared with colleagues. As of summer, 2007, HST trainees in all courses are receiving an email impact assessment survey three months after taking the course.

Also as of late 2007, all registrants are being asked to supply ethnicity data on their course registrations.

Outcomes/Relevance/Impact

The HST Program is an innovative and widely known and respected regional training program which is sought out by target groups throughout the region. The Program receives yearly requests from a variety of groups including state hazardous materials conferences, the Environmental Protection Agency, state and county organizations, rural and community clinic organizations and Native American tribal agencies. Trainees, often covered by scholarships, represent minority and underserved populations (Hispanic and Native American) in addition to targeting state, county, municipal and federal government health and safety professionals.

While the average number of trainees was 50 per year during the early years from 1988-94, in the past five years, the number of trainees totaled 1,506 (in 56 classes) for a five-year average of approximately 300 trainees per year. That is a 500% increase from the early grant years.

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Attachment I

PROGRAM GRADUATES AND CONTINUING STUDENTS
Years 16-20
July 1, 2002 – June 30, 2007
** Indicates Student Without NIOSH Funding

OCCUPATIONAL MEDICINE RESIDENTS GRADUATES, UCSF

Jim Brent Page, '02 MPH '03
Faculty

Bruce Hoang, 03
Occupational Medicine

Jayshree Chander, '03 MPH
Withdrew after MPH

Sandra Morrow, '03
Occupational Medicine

Jefferey Gao, '04
Occupational Medicine

Kenichi Carrigan, '05
Assistant Medical Director
Occupational Medicine

Charles La Rouche, '05
Occupational Medicine

Miriam Shipp, '05
Occupational Medicine

Chris Wang, '05
Occupational Medicine

Josef Thundiyil, '06
Occupational Medicine
Professor, Occupational Medicine,

Sarah Janssen, '06
Research Scientist

Tatiana Mamantov, '06 MPH
Withdrew after MPH
Occupational Medicine

Effiem Abbah, '07
Occupational Medicine

OCCUPATIONAL MEDICINE RESIDENTS CONTINUING STUDENTS, UCSF

Michael Gallagher, (2008 Estimated)
Oakland, CA

Shelley Arredondo, (2008 Estimated)
San Francisco, CA

Sandeep Guntur (2009 Estimated)
San Francisco, CA

OCCUPATIONAL HEALTH NURSING GRADUATES, UCSF

Dorit Betschart, MS, '03
OHNP

Cynthia Gonzalez, MS, '03
On Maternity Leave
Volunteer Adult Nurse Practitioner

Bruncelia Hynson, MS, '03
Adult Nurse Practitioner

Lynette Landry, PhD, '03
Assistant Professor

Mary Owen, MS, '03
Adult Nurse Practitioner

Be Thi Pham, MS, '03
Occupational Health Nurse Practitioner

Claudia Praglin, MS, '03
Adult Nurse Practitioner

Catherine Prosser, MS, ‘03
Manager, Emergency Services

Kathleen Ruel, MS, ‘03
Occupational Health Nurse Practitioner
(retired) ; Nurse Practitioner

Janheen Pascual (Trias), MS, ‘03
Adult Nurse Practitioner

Irina Foxman, MS, ‘03
Occupational Health Nurse Practitioner

Jason Libby, MS, ‘03
Adult Nurse Practitioner

Evelyn Wong, MS, ‘03
Consultant
Public Health Nurse

Charlottee Andreasen, MS, ‘04
Occupational Health Nurse Practitioner

Michael Lawrence, MS, ‘04
Assistant Manager

Jason Aucoin, MS, ‘04
Occupational Health Nurse Practitioner

Ricardo Ballin
Withdrew ’04, MS Program

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OEH Clinical Nurse Specialist

Ann Dinh, MS, ‘04
Occupational Health Nurse Practitioner
Manager, Occupational Health Services

Jonathon Ford
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Arleen Ervin King, MS, ’04
Occupational Health Nurse Practitioner

Joan O’Mahony, MS, ‘04
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Kin Cheung, PhD, ‘04**
Faculty

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Roy Tatlonghari, MS, ‘04
Occupational Health Nurse Practitioner

Nicole Wilson Collman, MS, ‘04
Employee Health Nurse Practitioner

Linda Dulong, MS, ‘05
Adult Nurse Practitioner

Anna Elliott, MS, ‘05,
OEH Clinical Nurse Specialist

Emily Fisher, MS, ‘05
Occupational Health Nurse Practitioner

Kanne, Melissa, MS, ‘05
Occupational Health Nurse Practitioner

Beth Sherry, MS, ‘05
Hospital Staff Nurse

Kristina Beloso, MS, ‘06
Adult Nurse Practitioner

Daniel Bertheau, MS, 06, MPH**, ‘07
Current job search
Clinical Staff Nurse
(Note: first graduate of MS/MPH program in conjunction with UC Berkeley)

Dana Drew Nord, MS, ‘06
Occupational Health Nurse Practitioner
Doctoral Student - OEHN

Elaina (Ji-Soo) Huong, MS, ‘06
Clinical Staff Nurse

Meredith Gajda, MS, ‘06
Occupational Health Nurse Practitioner
Kathleen Hagan, MS, ‘06
Faculty

Jane Inaura, MS, ‘06
Occupational Health Nurse Practitioner

Clarissa Santos, MS, ‘06
Adult Nurse Practitioner

Michelle Dawn Nance, MS, ‘06
Public Health Nurse/ Adult Nurse Practitioner

Heather Christensen, MS, ‘07
Research Nurse Practitioner

Elizabeth Clauson, MS, ‘07
Clinical Staff Nurse

OCCUPATIONAL HEALTH NURSING CONTINUTING STUDENTS, UCSF

Heather Barr, MS (TBA)
OHNP Student

Jennifer Borden, MS (TBA)
OHNP Student

Jennifer Christensen, MS (TBA)
OHNP Student

Heba Desouky, MS (TBA)
OHNP Student

Rasheda Jones, MS (TBA)
OHS Student

Stephanie Phelps, MS (TBA)
OHNP Student

Debra Rosett, MS (TBA)
OHNP Student
Consultant, Ergonomics Laboratory
Richmond, CA

Alberto Vajrabukka, Post Master’s Student**
OHNP Student

Burgel, Barbara, PhD (TBA)
Clinical Professor
OEHN Program

Mary Foley, PhD (TBA)**
Faculty – Patient Safety Initiative

Pamela Foreman, PhD (December, 2007)**
Manager, Regional Employee Health Services

Christina Foushee, PhD (TBA)
Clinical Research Nurse

Soo-Jeong Lee, PhD (September, 2007)**
Research Associate

Kathleen Mullen, PhD (September, 2007)
Medical Legal Consultant

Elizabeth Thomas, PhD (TBA)**
Gordon and Betty Moore Scholar

Industrial Hygiene Graduates
UC Berkeley

Sarah Ash, MPH ‘03
Environmental Health and Safety

Linda Guandalini, MPH ‘03
Industrial Hygienist

Clement Hsieh, MPH ‘03
Assistant Industrial Hygienist

Rachael Jones, MPH ‘03
Doctoral Student - IH

Angela Menegay, MPH ‘03
Associate

Kathleen Vork, PhD ‘03
Research Scientist

Michael Wilson, PhD ‘03
Research Scientist

Krista Cole, MPH ‘04
Occupational Safety Engineer

Kamilah Munir, MPH ‘04
Industrial Hygienist

Maria Ta Tchong, MPH ‘04
Research Industrial Hygienist

Ingrid Zubieta, MPH ‘04
EHS&S Industrial Hygienist

Sa Liu, MPH ‘05
Doctoral Student - IH

Natalia Varshavski, MPH ‘05
Industrial Hygienist

Matthew Carlson, MPH ‘06
Environmental Health Specialist

Helen Song, MPH ‘06
IH Employment Search

Naomi Ufberg, MPH ‘06
Medical School

Heather Madison, MPH ‘07
Industrial Hygienist (Pending)

Jonathan Leong, MPH ‘07
Environmental Health Specialist

Industrial Hygiene Students
Currently In-Training, UC Berkeley

Lesliam Quiros, PhD (TBA)**
IH Doctoral Student

Linda Kincaid, (Leave of Absence)**
IH Master's Student
IH Consultant

Jacqueline Erbe, MPH (TBA)
IH In-Training

Matthew Rivard, MPH (TBA)
IH In-Training

Zulma Machillanda-Hahn, MPH (TBA)
HSAT In-Training

Daniel Best, MPH (TBA)
IH In-Training

Aaron Bennett, MS (TBA)
IH In-Training

Mike Posson, MPH (TBA)**
IH In-Training

Eva Raphael, MPH (TBA)
IH In-Training

ERGONOMICS PROGRAM GRADUATES BERKELEY/UCSF

Tom Hrushka, '03
PhD, Engineering
Consultant

Eric Schlossberg, '04
MS, Environmental Health Sciences
President

Loren Bentley, '04
PhD, Engineering
Scientist

Kathy Kursa, '05
PhD, Bioengineering
Scientist

Dan Odell, '05
PhD, Mechanical Engineering
Manager

Matt Rogers, '05
MS, Mechanical Engineering
PhD Student Mechanical Engineering

Pin-Chien Jason Wang, '05
PhD, Epidemology
Statistician

Hui Dong, 06
PhD, Environmental Health Sciences
Research Associate

Alfredo Villanueva, 06
MS, Bioengineering
Law School

Leena Nakama, 06
PhD, Bioengineering
Consultant

Krishna Asundi, 07
PhD, Bioengineering
Postdoctoral Scholar

Mina Nikanjam, 07
PhD, Bioengineering
Medical School

Pei-Yi Ko, 07
MS, Vision Sciences

ERGONOMICS STUDENTS CURRENTLY IN-TRAINING

Carisa Harris-Adamson, PhD (TBA)
Environmental Health Sciences

Pei-Yi Ko, MPH (TBA)
Environmental Health Sciences

Michael Wehrner, PhD (TBA)
Mechanical Engineering

Molly Story, PhD (TBA)**
Environmental Health Sciences