Primary Investigator: John Balmes, MD │ UC Berkeley/UCSF │ jbalmes@berkeley.edu 510-220-0502

Occupational Safety and Health Educational and Research Centers

Grant Number: T42OH008429

Project Dates: 7/1/2015 – 6/30/2020

Report Date: September 30, 2020

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List of Abbreviations

AAOHN	American Association of Occupational Health Nurses
ACGME	Accreditation Council for Graduate Medical Education
AGPCNP	Adult Gerontology Primary Care Nurse Practitioner
AIHCe	American Industrial Hygienists Conference & Expo
APRN	Advanced Practice Nurse
ASEAN	Association of Southeast Asian Nations
ASH	Agricultural Safety and Health
BCPE	Board of Certified Professional Ergonomists
Cal-OSHA	California Occupational Safety and Health Administration
CDC	Center for Disease Control
CE	Continuing Education
CECRAOHN	California El Camino Real Association of Occupational Health Nurses
CEUs	Continuing Education Units
CIH	Certified Industrial Hygienist
COEH	Center for Occupational and Environmental Health
COVID-19	Coronavirus Disease 2019
CPWR	The Center for Construction Research and Training
EAB	External Advisory Board
EHS	Environmental Health Sciences
EPICOH	Epidemiology in Occupational Health Conference
ERC	Education and Research Centers
FOHNEU	Federation of Occupational Health Nurses within the European Union
HFE	Human Factors and Ergonomics
HRSA	Health Resources and Services Administration
IDACs	Interdisciplinary Activities and Collaborations
IH	Industrial Hygiene
KPIs	Key Performance Indicators
LOHP	Labor Occupational Health Program
MPH	Masters of Public Health
MS	Master of Science
MWF	Metal Working Fluids
NIH	National Institutes on Health
NIOSH	The National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NORA	National Occupational Research Agenda
NorCal-ERC	Northern California Education and Research Center
OCC EPI	Occupational Epidemiology
OE	Occupational Epidemiology
OEH	Occupational and Environmental Health
OEHN	Occupational and Environmental Health Nursing

OEM	Occupational and Environmental Medicine
OEPI	Occupational Epidemiology
OH	Occupational Health
OHIP	Occupational Health Internship Program
OOMPH	Online Master of Public Health (Program)
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PCS	Post Concussive Symptoms
PEHSU	Pediatric Environmental Health Specialty Unit
PhD	Doctor of Philosophy
PLA	Program Letter of Agreement
PLA	Program Letters of Affiliation
PPE	Personal Protective Equipment
R2P	Research to Practice
RTW	Return to Work
SON	School of Nursing
SPH	School of Public Health
STEER	Short Term Educational Experiences in Environmental Health Research (Internship)
SWOT	Successes Weaknesses Opportunities and Threats
TAA	Training Affiliation Agreement
TBI	Traumatic Brain Injury
TRT	Tartgeted Resarch Training Program
UAW-GM	United Autoworkers - General Motors
UC	University of California
UCB	University of California, Berkeley
UCD	UC Davis
UCSF	University of California, San Francisco
URM	Underrepresented Minorities
ZSFG	Zuckerberg San Francisco General

Abstract

The Northern California Education and Research Center (ERC) is part of the Center for Occupational and Environmental Health (COEH), a consortium of programs at three campuses of the University of California - UC Berkeley, UC San Francisco and UC Davis-- with institutionally committed funding to provide training, research, and outreach to protect the health of workers and communities. We promote healthy workplaces and environments that protect workers and communities from health hazards through teaching, research, and service. We serve government, industry, schools, health professionals, and the public through programs and partnerships designed to deepen the understanding of occupational and environmental hazards, and to prevent disease and injuries by:

- *Educating health professionals to be practitioner leaders in occupational and environmental health and safety.*
- *Developing new knowledge through an interdisciplinary research agenda focused on bridging knowledge gaps critical to preventing illness and injury and promoting health.*
- *Responding to the needs of people affected by hazards in their workplaces or communities, with special attention to vulnerable populations and through commitment to diversity in faculty, staff, and trainees.*

We have six core-academic and one research training program that provide intensive mentorship for trainees pursuing practice and research-based careers in: 1) Occupational and Environmental Medicine; 2) Occupational and Environmental Health Nursing; 3) Agricultural Safety and Health; 4) Ergonomics; 5) Industrial Hygiene; and 6) Occupational Epidemiology. To address the needs of the larger occupational health and safety community, our Continuing Education & Labor Occupational Health Programs provide trainings to promote best practices, share the latest research, and facilitate research to practice initiatives, providing key connections among academics, researchers, students, workers, labor organization groups, and employers.

Over the course of this five-year grant, our ERC addressed many high priority occupational health issues such as ladder safety, robotics in agriculture, exoskeletons, wildland firefighter smoke exposure, and suicide. Our ERC has close to 97 faculty (35 core & 62 affiliated) that mentored 162 students (115 ERC Trainees) through Masters(N=68), PhD(N=85), and Medical Resident (N=26) programs. Our faculty and students contributed more than 400 manuscripts and book chapters to the literature and hundreds more presentations at national and international conferences. Further, our work has contributed to numerous Cal/OSHA Standards aimed at protecting the health of workers. Our Continuing Education and Outreach Programs hosted more than 280 courses serving 13,665 learners with more than 61,619 total person-hours of training. Additionally, industry specific trainings were provided to more than 1,500 individuals per year in construction, healthcare, retail, schools, nail salons, hotels, janitorial, hotel and hospitality, domestic work, childcare centers, construction, recycling and food processing industries.

Our ERC responded comprehensively to the COVID-19 pandemic by helping to manage the surge at Call Centers, developing response algorithms, performing contact tracings, and developing community education tools to encourage proper PPE. Our research addressed multiple topics such as farm and grocery worker vulnerability, aerosol dynamics within elevators, and exposure among wildland firefighters. Collaboratively, we provided trainings to more than 2,000 workers and organizations with essential workers.

Northern California NIOSH Education & Research Center
Final Progress Report (July 1, 2015 – June 30, 2020)

Center Wide Activities (CWA)

Overview

This report summarizes the activity of the Center Wide Administration of the Northern California Education and Research Center (NorCal-ERC) over the period of July 1, 2015 through June 30, 2020. The NorCal-ERC is part of the Center for Occupational and Environmental Health (COEH), a consortium of programs at three campuses of the University of California (UC) - University of California, Berkeley (UCB), University of California, San Francisco (UCSF) and University of California, Davis (UCD) - with institutionally committed funding to provide training, research, and outreach to protect the health of workers and communities. COEH was founded in 1978 and became a NIOSH Education & Research Center in 1980.

Our vision is to promote healthy workplaces and environments that protect workers and communities from occupational and environmental health hazards through teaching, research, and service.

Our mission is to serve government, industry, schools, health professionals, and the general public through programs and partnerships designed to deepen understanding of occupational and environmental hazards, and to prevent disease, fatalities, and injuries. We accomplish this by:

- *Educating health professionals to be leaders in occupational and environmental health.*
- *Developing new knowledge through an interdisciplinary research agenda focused on preventing illness and injury.*
- *Responding to the needs of people affected by hazards in their workplaces or communities, with special attention to vulnerable populations.*

Our core academic programs include occupational and environmental medicine (OEM), occupational and environmental health nursing (OEHN), agricultural safety and health (ASH), ergonomics (ERGO), industrial hygiene (IH), and occupational epidemiology (OE). These programs provide financial support and intensive mentorship for students interested in pursuing research-based careers. To address the needs of the larger occupational health and safety community, our Continuing Education (CE) program provides numerous classes, workshops and webinars to promote best practices, share the latest research, and meet professional (re)certification licensure needs. To ensure effective research to practice, our Labor Occupational Health Program (LOHP) leads community outreach efforts and provides a key connection between academics, researchers, students, workers and labor organization groups.

We underscore the vital importance of past, present and future funding from NIOSH; given the specialization of this program and nature of its specialized focus and cross-disciplinary curriculum, the NIOSH ERC training grant provides core funding that supports Occupational Safety & Health (OSH) Programs at three Universities and allows us to augment program funding from other sources. This report provides an overview of our accomplishments in terms of Center Wide Administration growth that supports our mission - training, research and outreach - that supports a safer and healthier workforce. Given the challenges of training students in this era of COVID-19, this report will also summarize some of the modifications in training, research and outreach agendas that have met this new need.

Accomplishments over the Project Period

Center Wide Focus on Diversity & Inclusion

Our center has taken important steps to increase diversity, starting with our leadership and staff where 4 of 7 individuals are from underrepresented minority (URM) groups (African American and Hispanic). Our programs have also taken intentional steps to increase the number of students who are URMs, persons with disabilities or US Veterans; 10%-35% of students in each program represent these groups with the exception of the Agricultural and Safety Health, which represents 80%. During this program period, we initiated a Diversity,

Equity & Inclusion Committee that has representation from most programs. Together, we developed a 4-prong approach to increasing DEI including:

- Revising the recruitment strategy for incoming students to support DEI
- Providing additional support to students upon arrival to ensure their success
- Developing partnerships with local outreach groups to promote OSH as a career track among High School, Junior College and State College Students
- Working more closely with the UC Berkeley Dream Office to promote OSH to undergraduate students of color

Program Evaluation & Strategic Planning

The evaluation of our Center and each program includes both quantitative and qualitative approaches. From a quantitative perspective, we have developed program workbooks to collect critical information on trainees, faculty, input (grants), output (papers, book chapters, conference proceedings etc.), awards and outreach efforts from each program. We have developed key performance indicators (KPIs) that will help programs compare their progress year over year; we also developed plans to aggregate KPIs across programs to summarize Center Wide performance, impact and opportunities for improvements. Some highlights of the data are included in the accomplishments section below.

From a qualitative approach, over the project period, we surveyed occupational safety and health (OSH) professionals in Region 9 about professional and educational needs. Their feedback can be categorized into the following expectations:

- Respond to immediate health and safety needs
- Mentor professionals in their work positions by providing CE, resource materials and the latest solutions to ongoing OSH concerns
- Serve as advocates for influencing regulatory agencies about safety standards; monitor standards and rule making
- Understand business needs and how to best consult with industry
- Train future OSH professionals with safety skills, EHS management skills, cultural and language skills to meet the needs of a diverse workforce

Our program evaluation plan also solicited feedback from students and alumni about their experience with curriculum, practical training, mentorship and preparedness for the workforce. The CWA provides support to programs by disseminating surveys, aggregating data and discussing it at meetings to support a continuous improvement process. Additionally, at the end of the project period, the CWA recruited the Health Research Action team to support our center wide evaluation efforts. Their knowledge and expertise in evaluating statewide programs have been an integral part of improving our tools and approach to center and program evaluation.

Interdisciplinary Activities & Collaboration

One of the strengths of the NorCal-ERC is the multitude and variety of programs that we have across three campuses that specialize in agriculture, medicine and public health. This provides unique opportunities for interdisciplinary activities and collaboration (IDACs) between OSH trainees and faculty that span training, research and outreach including:

- Over 28 courses that include trainees from at least 2 and up to 6 academic programs
- Field trips that include trainees from 2-4 programs at a time
- Summer internship opportunities with LOHP to support advocacy training
- Webinars, symposiums and get togethers that include attendees from all 9 programs
- Our Targeted Research Training Program provides general training in ethics and research to all trainees
- Continuing Education Classes taken by trainees from various programs with professionals from different OSH areas of specialization
- Research projects that intentionally recruit trainees from different disciplines

Center Wide Outreach
We have focused on expanding our education, training and services beyond Northern California to serve all of Region 9. Given there is a Southern California-ERC, which traditionally focuses on Arizona and Southern California, our outreach focuses on Northern California, Nevada, Hawaii and other Pacific Islands. Having Region 9 representation on our EAB from these areas has been important and helped us develop alliances with local professional groups in Nevada and Hawaii. These alliances have been key to outreach efforts in these states and have led to in-person symposia on Occupational Health in both Hawaii and Nevada that are designed to fit the needs of the specific states. For example, our colleagues in Hawaii have indicated the need for updates on total worker health research and best practices while our colleagues in Nevada have identified needs for updates relevant to the mining and hotel/casino industries.

Expanded External Advisory Board
We highly value the input provided from our EAB and respond quickly to their suggestions. For example, we have retooled our CE program making our webinars free with Continuing Education (CE) certificates available upon their completion. We have made many changes to our Fundamentals of Industrial Hygiene and Occupational Health & Safety classes based on EAB feedback. Most recently, EAB advisors suggested that we add more industry-specific content to our Occupational Health and Safety class. This suggestion is being implemented through a new curriculum where students will be introduced to industry-specific safety concerns through guest lectures from practitioners in various industries. We expanded on this suggestion and are developing in-person safety skills workshops in the new Human Factors and Ergonomics Work Simulation Center. The workshops, temporarily paused due to COVID-19, will cover personal protective equipment, ladder safety, fall prevention training, and lock-out/tag-out procedures using case-based scenarios and simulated work environments.

Program Highlights
- The OEM Residency Program has the largest number of trainees in the country, currently nine, and successfully received a competitive renewal of a Health Resources and Services Administration (HRSA) grant, one of the few that has been awarded to an OEM training program.
- OEHN Trainees received more than 20 grants and awards including AAOHN Conference First Place for poster presentation and the Jayne M. Perkins Memorial Award.
- ASH worked on projects focused on ladder safety, robotics in agriculture and the application of exoskeletons to agriculture. One trainee presented her work to a panel of advocates, attorneys, and community leaders involved in the prevention of sexual harassment in agriculture.
- Two PhD ERGO trainees assessed the effectiveness of shoulder and torso exoskeletons on reducing muscle activity and fatigue while performing overhead or lifting tasks led to a larger 5-year study to develop exoskeleton guidelines for construction workers.
- IH students now complete an integrated learning experience capstone project; trainees have tackled emerging issues such as injury experiences of household workers in California and hazards in the cannabis industry. IH PhD student Kat Navarro received over 9 scholarships and awards for her work on the health impacts of smoke among wildland firefighters.
- The faculty of the academic programs take great pride in developing future leaders in their fields. Erika Garcia, a recent OCC EPI PhD graduate, did her dissertation work on the impact of exposure to metalworking fluids in the automobile manufacturing industry and risks of breast and lung cancer. After publishing multiple papers, she is now an Assistant Professor at the USC School of Medicine.
- Out of seven TRT trainees, three of the awardees (43%) were from URM backgrounds (Latinas). Four of these trainees have graduated with their PhDs; the other three are still in the TRT Program.
- CE has been instrumental in coordinating ERC Collaborations by launching the NIOSH ERC Ergonomic Webinar Series where a different ERC presented on a different topic each month. The Webinars are free and have been attended by over 600 individuals. An IH series will be launched in 2020.
- LOHP was instrumental in providing training to vulnerable workers on key emerging issues and new Cal/OSHA standards including sexual harassment and assault prevention, heat illness prevention program,

wildfire smoke exposures for day laborers and agriculture workers, and implementation of the Hotel Housekeeping Musculoskeletal Injury & Illness Prevention Standard.

- Each Program Director is a nationally and internationally renowned expert in their field; collectively, they serve on numerous advisory committees for national and international organizations, give keynote addresses at international conferences and have received prestigious awards

A.4 Center-Wide Deliverables

Our Center-Wide metrics follow the logic model presented in the Planning & Evaluation section; highlights include:

Inputs

- There are 35 core and 62 affiliated faculty that support the NorCal-ERC program contributing time, expertise, research opportunities, and mentorship to students.
- Core faculty of the NorCal-ERC raised an average of approximately $4M per year in funded research that addressed regional and national research needs and trained additional students in OSH.

Activities

- There have been 162 students across six academic programs. These include 68 Masters Students, 85 PhD students and 26 Medical Residents. Of these, 115 have been supported by the NIOSH NorCal-ERC Training grant.
- CE has hosted 281 courses from FY15-16 to FY19-20, serving 13,665 learners with 61,619 total person-hours of training.
- LOHP has directly reached approximately 1,500 individuals a year in a range of industries, including construction, health care, retail, schools, nail salons, hotels, janitorial, hotel and hospitality, domestic work, childcare centers, construction, recycling and food processing.

Outputs

- 93 students from the current reporting period have completed their graduate studies; 88%were employed in an OSH career immediately upon graduation.
- Across all CE courses, an average of 71% of evaluation respondents indicated they were somewhat to very likely to change their practice as a result of courses taken.

Outcomes

- NorCal-ERC faculty and students have contributed more than 400 manuscripts and book chapters to the literature over the program period and hundreds more presentations at national and international conferences. Students have contributed to more than half of these publications and presentations [OEHN (42); OEM (75); OCC EPI (44); ERGO (47); ASH (8); IH (15); TRT (18)]
- Programs collaborate with a variety of companies reflecting key industries in Region 9 including biotechnology, agriculture, warehousing, manufacturing, autoworkers, construction, hotel housekeeping, computer, technology, and mining.

Impacts

- The Bay Area Solvent Study identified hexane use in brake cleaners as a cause of peripheral neuropathy among auto technicians, and persuaded manufacturers to remove hexane from their products.
- Our research into the health effects of metal working fluids (MWF) provided the scientific basis for General Motors and the UAW to negotiate a new internal PEL for MWF of 0.5 mg/m3, less than a tenth of the only existing standards as particles not otherwise classified.
- Our earlier studies showing the association of diesel exhaust exposure among railroad workers and lung cancer provided the basis for the California Air Resources Board, of which Dr. Balmes is the Physician Member, to declare diesel exhaust to be a Toxic Air Contaminant laying the foundation for the state's aggressive regulation of diesel exhaust emissions.
- Our faculty have been directly involved in the development, approval and implementation of multiple Cal/OSHA Standards including the Workplace Violence Prevention (Section 3343), the Heat Illness Prevention Standard (Section 3395), the Health Care Worker Back and Musculoskeletal Injury Prevention (Section 5120), the Hotel Housekeeping Musculoskeletal Injury & Illness Prevention Plan (Section 3345) and the Wildfire Smoke Emergency Standard (Section 5141.1).

COVID-19 related Program Initiatives (March 2020-June 2020)

The importance of Occupational Health has been more apparent than this past year as the COVID-19 pandemic spread across the US. Along with other ERCs across the country, we were able to help respond to this unprecedented challenge through resilience in teaching, shifting research priorities and a focus on COVID-19 training and outreach to our community. Some examples of our response include:

- Training activities were modified to accommodate distance learning:
  - All classes transitioned to online seamlessly within days of the March Shelter in Place order.
  - Field trips went virtual; some may continue to be virtual after the pandemic
  - Summer internships were either modified to accommodate the shelter in place orders or replaced with new projects were provided that focused on COVID-19 responses.
- Research projects included high impact projects assessing:
  - ASH Program Director and several trainers were involved in supporting the California-wide COVID-19 Farmworker Study (COFS), which looked at the evidence of California farmworker vulnerability during the COVID-19 pandemic.
  - An interdisciplinary effort (ERGO, LOHP, OCC EPI, TRT and OEM) investigated the Impact of COVID-19 on Grocery Workers in California.
  - Drs. Hong (OEHN) and Blanc (OEM) and their faculty and trainees worked closely with the UCSF Medical Center COVID response team and the San Francisco Department of Public Health to help manage the surge at the Call Center and the Occ Health/Employee Health tracings.
  - IH (Drs. Hammond and Noth) are measuring aerosol dynamics within campus elevators to understand how long aerosol particles remain in the air in elevators.
  - IH created and disseminated an infographic for the general public on use of PPE during the pandemic, titled “Which Mask Do I Need?”
- Outreach activities included:
  - LOHP & CE provided 17 trainings and webinars targeted to ‘essential workers’, including janitors, domestic workers, airport workers, retail and delivery workers reached more than 2,000 workers and organizations.
  - CE/ ERGO developed *Ergonomic Tips for Working and Schooling at Home during COVID-19*
  - CE reviewed and aggregated resources to support NorCal-ERC administration and facilitate the launch of NorCal-ERC COVID-19 Resources and Information webpages.
  - CE convened an advisory group to develop two online, asynchronous courses on Working Safely during the COVID-19 Pandemic.
  - Dr. Balmes participated in a U.S. Forest Service webinar regarding the impact of the COVID-19 pandemic on wildland firefighting and has been interviewed multiple times on local and national media regarding the nexus of occupational exposures to wildfire smoke and COVID-19.

Occupational and Environmental Health Nursing (OEHN) Program, UCSF

Program Description: The program offers Master of Science (MS) and Doctor of Philosophy (PhD) degrees. The MS program is a two-year Adult-Gerontology Primary Care Nurse Practitioner (AGPCNP)-OEH focus. Over the 5-year period of July 1, 2015 through June 30, 2020, the program graduated a total of 37 MSs and 6 PhDs.

Goals and objectives: To prepare advanced practice nurses, researchers, and educators with expertise in OEH in order to become leaders in their field. OEH students are prepared to develop, implement and evaluate OEH programs including occupational injury and illness prevention and/or return to work, case management, and health promotion and risk reduction programs. NP graduates diagnose and treat occupational injuries and illnesses in collaboration with other disciplines. PhD graduates contribute to OH knowledge development through research and assume leadership roles in their profession.

Leadership During the reporting period, the OEHN program was under the leadership of Dr. Hong. She has been involved in various levels of student work, including MS and PhD course and curriculum development, recruitment of quality students from diverse backgrounds, MS students' comprehensive examinations, serving on several doctoral qualification exam and dissertation committees, and research training for postdoctoral fellows funded by other sources such as the Global Korean Nursing Foundation. She was also appointed as the Director of the UCSF School of Nursing (SON) PhD program in 2017 to oversee the research training for over 60 nursing PhD students in the SON. Dr. Hong was ably assisted in the MS clinical training program by a strong team of NP faculty members (Dr. Burgel until her retirement in 2017 and Dr. Drew-Nord until her retirement in 2018; and beginning in 2018, Dr. Hill, Ms. Collman, and Ms. Domeracki) whose almost 100 years of combined OEH clinical experience brings breadth and depth to the program. Dr. Lee's research and curriculum development skills round out the strengths of the core faculty.

Along with her ongoing teaching, curriculum development, and student recruitment efforts, Dr. Hong also has provided leadership by creating and strengthening international collaborations in OEHN education and research and expanding the growing theme of globalization in OEHN. Her leadership in, and contributions to international OEHN education and research has been recognized. She received the Margretta Madden Styles Award from the Alpha Eta Chapter of Sigma Theta Tau International Honor Society of Nursing for her excellence in nursing education, clinical practice, and national and international policy-making; awarded Global Leader in Doctoral Education Award by the International Network of Doctoral Education in Nursing; named as a member of the Scientific Committee by the Federation of Occupational Health Nurses within the European Union (FOHNEU) and was the keynote speaker for 2019 FOHNEU International Congress. Dr. Hong completed her 4-year service as the President of the Global Korean Nursing Foundation and received the Appreciation Award from the Foundation for her outstanding contributions and services; was appointed to the Advisory Board for Nővér: Hungarian Scientific and Education Journal of Nursing Theory and Practice. She was invited by the Thai Occupational Health Nursing Association President to provide curriculum development consultation to build capacity for nurses in countries of the Association of Southeast Asian Nations (ASEAN) and was invited by Taiwanese OSHA to provide research and curricular expertise for the development of OHN specialty in Taiwan. She continues her contributions to nursing and OEH scholarship by being reappointed to the Editorial Board for Nursing Research. Dr. Hong's prevention of occupational noise-induced hearing loss and tinnitus research projects has long been recognized both nationally and internationally for its immediate applicability to the various industries, specifically, construction and fire services.

Program Update During the reporting period, minor curriculum changes were made to the MS program (see below, Curricula) and no changes were made to the PhD program. Highlights during this last review period are as follow:

Faculty promotion, retirement, appointment: Two longtime OEHN core faculty, Drs. Burgel and Drew-Nord retired but will continue to participate in the program as volunteer faculty members. Three new clinical faculty

Ms. Collman, Ms. Domeracki, and Dr. Hill were hired in 2018. Due to personal reasons, Dr. Hill left the program in 2019. Both Ms. Collman (MS, 2005) and Dr. Hill (MS in 2005 and PhD in 2014) are graduates of the UCSF OEHN program. Ms. Domeracki has been a clinical preceptor and a volunteer faculty for the program since 2005 before being hired as an associate clinical professor. Dr. Buss (OEHN PhD alum and the former COEH deputy director) was appointed as a volunteer faculty in fall 2018.

Curricula: Two new courses (Essentials of human genomics for nurses and Palliative care) were added to SON's MS core courses.

OEHN Program Advisory Board: The Advisory Board was created in 2019 and is made up of fourteen distinguished OEHN professionals from California, Nevada and Hawaii. The Advisory Board is focusing on recruitment of students, Critical Elements for graduates, and Curriculum Planning. The Advisory Board meets once a quarter.

Faculty Participation: The Program Director (Dr. Hong) provided leadership in research training for PhD students, programmatic curriculum enhancement, and recruitment of quality students from diverse backgrounds. Dr. Hong taught the OEHN seminar course for MS students and research seminar course for PhD students and served on several doctoral qualification exam and dissertation committees. Dr. Lee taught Occupational Health & Diverse Worker Populations (273A), Principles & Methods of Epidemiology (N212C) and co-taught the introduction to OEHN course (N273A) with Dr. Hill. Dr. Lee also mentored PhD students for research training, qualifying examination and dissertation research. Ms. Collman, Ms. Domeracki and Drs. Drew-Nord and Hill were responsible for the clinical aspect of the OEH NP programs. Ms. Collman plans the OEH-NP students' clinical practica and provides clinical supervision for the MS students, teaches OEHN role (N414.02A) and program planning practica (N414.02B) and manages clinical training for 2nd-year MS students (N415.28B). She assumes recruitment and screening responsibilities for MS applicants. Ms. Domeracki co-teaches an OEH illness and injury management course (N271.06) with Dr. Blanc, OEM Program Director and manages the clinical training for 1st-year students (N414.28). The core and affiliated OEHN program faculty included experts with skills in OEH clinical management (Drs. Blanc & Hill, Ms. Collman, and Ms. Domeracki), program planning and primary care (Ms. Collman), epidemiology (Drs. Lee, Bates, & Eisen), occupational hearing loss (Dr. Hong), and worker training and behavioral intervention (Drs. Hill, Hong & Lee, Ms. Collman, and Ms. Domeracki). Faculty also offer expertise in IH and safety (Drs. Harris-Adamson & Materna), toxicology (Dr. Goldman), ergonomics and musculoskeletal disorders (Drs. Harris-Adamson & Lee), pulmonary disorders (Drs. Blanc & Balmes), cardiovascular diseases (Dr. Hong), environmental health (Drs. Alkon, Hong, & Balmes), occupational injury (Drs. Hong & Lee), and occupational health surveillance (Dr. Lee). The affiliated faculty have shared responsibility for teaching OEHN core courses and provided expertise and curricular support to the OEHN Program and significant interdisciplinary collaboration to the program. Along with Dr. Hong, Dr. Drew-Nord and Ms. Collman provided mentoring to new clinical faculty, Ms. Domeracki and Dr. Hill for their academic career development. Former program directors, Drs. Faucett and Gillen, and 2017 retiree, Dr. Burgel continued to offer valuable guidance to OEHN program faculty.

Scholarship: OEHN Program faculty and students showed outstanding performance in research and scholarship with 132 peer-reviewed publications, 4 book chapters, and 39 funded education and research projects (16 ongoing and 23 completed). Several students received awards for their excellence in scholarly work and grants to support their research: Singleton (Jeanie Schmit Kayser-Jones Scholarship; AAOHN Foundation Academic Studies Scholarship, Jonas Scholar Fellowship; Rosenberg Hill Fellow; and the Substance Abuse and Mental Health Services Administrative Minority Fellow; Jayne M. Perkins Memorial Award; AAOHN Foundation UPS Scholarship, Occupational Health Internship Program [OHIP]), Odes and Hemmerle (UCSF Clinical and Translational Research Fellowship), Khatsenko (Kaiser Permanente Dolores Jones Scholarship; AAOHN Foundation UPS Scholarship), Swartz (Jonas Scholar Fellowship for Environmental Health Nursing), Strozier (OSHA Nurse Internship Program), Widyastami and Soh (Kaiser Permanente Delores Jones Scholarship), Surrat (OHIP; National Health Service Corps Scholarship), Phelps (CSAOHN Moore Medical Excellence Award; AAOHN Scholarship; Golden Pen Novice Author Award by Workplace Health and Safety, the Official Journal of the AAOHN), Michalchuk (AAOHN Conference First Place of poster presentation), and Grant (UCSF School of Nursing 2020 Meritorious Service Award).

Successful R2P: Dr. Hong's prevention of occupational noise-induced hearing loss and tinnitus research projects has long been recognized for its immediate applicability to the various industries, specifically, construction and fire services. Dr. Hong has established a new research collaboration with an American Indian (Cherokee) researcher (Dr. John Lowe) at the Florida State University Center for Indigenous Nursing Research for Health Equity to culturally modify and implement her noise-induced hearing loss prevention intervention for American Indians in construction. Dr. Hong is researching the "Effects and cost-effectiveness of an mHealth intervention to improve diet, physical activity and sedentary behavior among sedentary workers."

Dr. Hong and her PhD advisee (Hemmerle) established a collaborative project with a multidisciplinary team at the San Francisco General Hospital on return to work after traumatic brain injury and spinal code injury. Dr. Hong and her PhD advisee (Odes) established a collaborative project on violence in the healthcare workplace with a multidisciplinary team at the San Francisco VA Health Care System (PI: Natalie Purcell). Odes also initiated collaboration with an interdisciplinary research team at the California Department of Public Health to evaluate implementation of workplace violence legislation. Dr. Hong and her PhD advisee (Phelps) provided the research data and mentoring for a Short-term training in environmenal expsure research (STEER) fellow to investigate occupational stress and tinnitus in firefighters. Dr. Lee continued her research projects to evaluate the impact of safe patient handling legislation and regulation, with funding from a Department of Labor Research and Evaluation grant. Her work has a direct impact on workplace programs and intervention efforts to improve working conditions and safe work practices of healthcare workers and prevent musculoskeletal injuries. Dr. Lee collaborated with the California Department of Public Health, Occupational Health Branch (Harrison), the California Division of Workers' Compensation (Shor), and the COEH Labor Occupational Health Program (Stock) and disseminated her research findings to stakeholders such as OEH practitioners and nurse unions. Dr. Lee provided research mentoring to PhD students (OEHN: Michalchuk; non-OEHN: J. Lee and Kim) with her research projects. **Ms. Domeracki worked clinical case study reports collaboratively with UCSF OEM residents and faculty** through her clinical practice at **San Francisco VA Health Care System. Dr. Alkon's NIEHS R01 conducts a randomized intervention study to reduce pesticide exposures among preschool-age children in California childcare centers.**

Faculty and trainee contributions to regional, national and international OEHN field (see Dr. Hong's contributions under "Leadership.") Dr. Lee: serves as President of the California El Camino Real Association of Occupational Health Nurses (CECRAOHN); Chapter representative, California State Association of Occupational Health Nurses; appointed to the Editorial Boards for AAOHN Workplace Health & Safety, the Journal of Korean Academy of Community Health Nursing, and the Korean Journal of Occupational Health Nursing; served on grant review panels for CDC/NIOSH, Ontario Ministry of Labour, Canada, Oregon Institute of Occupational Health Sciences, and Hong Kong Polytechnic University, School of Nursing; Technical advisory group for California Division of Industrial Relation; Expert review panel for a study by the University of Kansas Medical Center School of Nursing; Scholarship Review for Global Korean Nursing Foundation; and invited to speak at international symposia by Kobe City College of Nursing, Japan and Korean Association of Occupational Health Nurses; and in 2020, became a Fellow of the American Association of Occupational Health Nurses (FAAOHN). Ms. Domeracki: elected as Communication Director of CECRAOHN and served as a Peer Review member, Workplace Health & Safety; and 2020 SFVAHCS Evidence Based Practice Fellow. Ms. Collman: served on the California State Occupational Health Nurses Conference planning committee. Dr. Wagner: invited to be the Inaugural Silvestri Endowed Speaker at the University of Nevada Las Vegas School of Nursing; appointed as a Technical Expert for the WHO-HQ Patient Safety and Risk Management Unit Global Patient Safety Challenge: Medication Without Harm Initiative. Dr. Burgel: spoke at the annual CSAOHN state conference on Standards Development in California; serves on the California Occupational Safety and Health Standards Board.

Our faculty and trainees have also contributed to and played significant leadership roles in conferences and symposia. Highlights include faculty presentations at the American Academy of Nursing (Dr. Hong); the 2nd Annual Conference for Advanced Practice Providers, and the Association of Occupational Health Professionals in Healthcare (Ms. Domeracki), the AAOHN conferences (Dr. Lee and Ms. Domeracki), the AAOHN Global Summit (Burgel, Buss, Hong, Lee), the 20th Congress of International Ergonomics Association (Dr. Lee), and Nurses Recognition Event, LA County Nurse's Week (Dr. Hill), the International Network for Doctoral Education in Nursing conference (Dr. Hong), the American Nurses Association Quality and Innovation Conference (Dr.

Hong), the International Symposium for Occupational Health of Nurses, Japan (Dr. Lee), the American Public Health Association (Dr. Alkon), and the UCSF Occupational and Environmental Medicine CME Conference (Drs. Hong & Lee, Ms. Hemmerle). Presentations at the International Congress in Nursing Informatics (Hong), Society for the Psychological Study of Culture, Ethnicity, and Race (Division 45 – American Psychological Association (Alkon), American Academy of Pediatrics (Alkon), Society for Research in Child Development (Alkon), 5th European Nursing Congress: Caring for Older People (Wagner), International Council of Nursing Conference (Hong), CSAOHN (Drew-Nord), Western Institute of Nursing (Burgel, Chin, Lee, Hong), American College of Rheumatology and the Association for Rheumatology Health Professionals (Greysen, Hong), California Harbor Area Association of Occupational Health Nurses (CHAAOHN) (Collman), World Congress on Nursing and CECRAOHN CE events (Lee, Ledesma, Carlos), Association for Clinical and Translational Science (Hong & Odes), Sigma Theta Tau International's 30th International Nursing Research Congress (Hong), 11th International Conference of Applied Human Factors and Ergonomics (Hong), 10th International Conference on Convergence Technology (Hong), 7th Federation of Occupational Health Nurses within the European Union (Hong) and CSAOHN Conference (Burgel).

PhD trainee Odes was a lead speaker for the continuing education program on worksite violence prevention organized by the Northern California Center for Occupational and Environmental Health. Several PhD students made presentations at the AAOHN (Michalchuk), APHA (Singleton), the NIH Translational Science Conference (Hemmerle and Odes), the NIOSH Total Worker Health International Symposium (Michalchuk), Neurotrauma International Congress (Hemmerle), the Western Institute of Nursing (Hemmerle, Odes, Michalchuk, Swartz), the CSAOHN Conference (Michalchuk and Odes), and CECRAOHN CE events (Hemmerle, Logarta & O'Rouke).

CE courses presented: The OEHN Program faculty along with a team of trainees has co-hosted biannual CECRAOHN CE programs, and faculty and PhD/MS students made presentations. Lee and Collman serve on CE Program Advisory Committee within the UC Northern CA Center for Occupational and Environmental Center (COEH); Burgel, Drew-Nord, and Lee have participated in CECRAOHN's CE program planning and offer a webinar on safe patient handling; Burgel presented at the annual Johnson & Johnson OHN Update and at the annual CSAOHN state conference on Standards Development in California, with a focus on the new emergency standard on prevention of Wildfire Smoke exposure; CECRAOHN members continue to receive a reduced registration rate for the Lela Morris COEH Symposium.

Current and Past Training Record. Our recruitment efforts have yielded highly qualified and motivated students during this funding cycle. Efforts include faculty presentations and student attendance at regional and national conferences (e.g., AAOHN, APHA, CSAOHN, and WIN annual meetings). We continue to recruit through websites, phone calls, annual OEHN recruitment meetings, e-mails, alumni and personal contacts. NIOSH training funds are critical to the success of these recruitment efforts. During the past five years, 37 MS students have graduated. Most graduates have been NIOSH-funded, although many of our students continue to receive other scholarships and awards that support their education. Nine students entered in fall 2019. During the past five years of the program, 6 PhD students (Buss, Joiner, Nouredini, Greysen, Phelps, and Swartz) have graduated, bringing the total to 27 PhD graduates. Four of PhD graduates are employed in academia (Buss, Joiner, Nouredini, Swartz), one (Phelp) in SF Fire Department, and one (Greysen) in the VA. For 2019-2020, there were 2 PhD students receiving NIOSH funds and 3 PhD (one international) students with other sources of funding. Four PhD trainees (Hemmerle, Michalchuk, Odes, & Singleton) successfully advanced to the candidacy and are currently working on their dissertation studies.

Response to COVID-19:

During the COVID-19 pandemic since March 2020, OEHN faculty, students, and alums have made significant contributions (teaching/mentoring, clinical rotations, creative/research, or service contributions) related to COVID-19. The Program Director, Dr. Hong has been in the UCSF SON leadership team to work closely with the UCSF Medical Center COVID-19 response team and the San Francisco Department of Public Health to help manage the surge at the Call Center and the Occupational Health/Employee Health tracings. Dr. Burgel (retiree) was recalled to UCSF to work on the COVID-19 Response team, specifically with return to work (RTW) guidance/contact tracing of employees who test positive for COVID-19. Nine of our OEHN MS students

(Choa, Gordon, Kimsey, Lama, Molina, Montag, Ornelas, Senders, and Zao) volunteered to work on several COVID-19 related projects at the UCSF Medical Center. OEHN faculty also developed and implemented clinical rotations for OEHN students to help manage COVID-19 pandemic (more detailed description is provided below). Dr. Burgel has been a leading faculty who has mentored and supervised nurses and staff members in the UCSF Medical Center's COVID-19 response team as well as graduate nursing students, including OEHN students. Several OEHN alums (Angelina Logarta, Jane Pun, and Cathy O'Connor) were also critical in helping mount the COVID-19 responses.

UCSF COVID-19 Employee Hotline: In Spring quarter 2020, 9 primarily 1st year APRN students completed clinical rotations at the Brisbane Call Center, focusing on employee questions, symptoms and exposures to COVID-19, with 2 students continuing through the summer. Approximately 50% of these students were in the specialty graduate program of OEHN. Learning objectives for this rotation included: 1) Gaining expertise in the COVID-19 clinical presentation of COVID-19, including symptoms and testing; 2) Applying triage protocols for the appropriate level of follow-up care, including low severity testing only, or referring the employee to the Video Ambulatory Care Clinic for a telehealth appointment, the Respiratory Screening Clinic for in-person clinical evaluation, or the Emergency Department; and 3) Applying return to work guidance for those with negative testing, in consultation with their on-site preceptor.

UCSF COVID-19 Contact Tracing Team: In Spring 2020, 6 primarily 2nd year APRN students participated in contact tracing either through the Occupational Health Services (OHS) (n=4) or the Hospital Epidemiology Infection Prevention Program (HEIP) (n=2). The majority of these students were in the specialty graduate program of OEHN. Learning objectives for this rotation included: 1) Gaining expertise in the clinical presentation of COVID-19, including symptoms and testing; 2) Conducting an index case interview for employees testing positive to determine if contact tracing was indicated; 3) Interviewing employees from the contact list to determine if they had exposure to the index case; and, 4) Educating contacts re: exposure, testing, symptom monitoring and return to work or home quarantine, if indicated, in consultation with their on-site preceptor.

***UCSF COVID-19 Case Classification Team*:** In Spring 2020, 1-2nd year APRN student, who was in the specialty graduate program of OEHN, participated in the COVID-19 Case Classification team for an evidence-based program planning rotation. Learning objectives for this rotation included: 1) Gaining expertise in the clinical presentation of COVID-19, including symptoms and testing; 2) Reviewing the literature on work-related vs. community acquired COVID-19 in health care personnel; 3) Conducting weekly case reviews, and participating in classifying the first 65 employee cases as likely acquired from occupational activities vs. likely due to community/household or travel activities. Student learning activities included conducting a review of the literature, doing extensive chart reviews, being an active member in the 4-member interprofessional Case Classification Team, and meeting weekly for case discussion meetings. The student additionally presented her findings at a regional professional OEH meeting and is a co-author on a publication in progress on the classification system used and the case classification employee outcomes in this academic medical center/campus environment.

Furthermore, several OEHN students participated in COVID-19 Hotline and Contact Tracing activities implemented by the San Francisco Department of Public Health. One MS student (Grant) participated as a project coordinator, in a COVID-19 seroprevalence (antibody) study with firefighters, which was initiated by UCSF OEH research team (PI: Dr. Harrison in OEM Program), in collaboration with the San Francisco Fire Department OEH team led by OEHN PhD graduate (Phelps). Dr. Hong facilitated the recruitment of nursing student volunteers to perform venipuncture sample collection. Ms. Grant along with Dr. Harrison presented the summary results at a Town Hall meeting to the SFFD leadership, union and front-line workers in August 2020. The study summary and the on-line presentation are available at https://sffd19.ucsf.edu/. This is one of the first COVID-19 serosurvey studies on front line urban first responders in the country.

Occupational and Environmental Medicine Residency Program, UCSF

Overview

This Progress Report summarizes the activity of the UCSF Occupational Environmental Medicine (OEM) residency training program over the period July 2015 through June 2020. Established in 1977, the UCSF OEM residency addresses the vital regional need for well-trained physician specialists in occupational medicine. The program is a component of the California state-funded Center for Occupational and Environmental Health (COEH). The COEH is the multi UC-campus entity within which the NIOSH-supported ERC is based. Since its founding, the UCSF OEM program has graduated over 100 physicians who work within and provide service in a variety of roles regionally and nationally. These include: 1. Academic affiliations with OEM (fulltime, part-time, or non-salaried voluntary teaching roles); 2. Positions in governmental agencies and non-governmental organizations; 3. Providing service and expertise in clinical settings (especially in the major provider network in California, the Kaiser Permanente Health Plan); 4. Acting as consultants to the public and private sectors, including to major information technology and biotechnology industries in the region such as Genentech and Google. The program is fully accredited by the ACGME for up to 10 trainees (a permanent increase approved in late 2019 and an increase of two positions over the award period of the since the last competitive renewal). Our program is currently one of the largest OEM residencies in the U.S. The mission of our UCSF OEM program remains to train graduates for clinical excellence, as leaders, and to be innovators in OEM. Our graduates are able to address current OEM issues while also being prepared to tackle future burden of emerging toxicants, increasingly vulnerable subpopulations (including aging workers), the adverse health effects of global climate change, gene-environment interactions, and even engage in “personalized” occupational medicine. We are proud to be successfully fulfilling our mission. We recognize the vital importance of past and ongoing NIOSH training grant support for the UCSF program. This NIOSH support not only has allowed us to train residents and carryout continuous program assessment and improvement, it also has given us leverage to seek out and augment additional support from other governmental and non-governmental funders. Finally, it is critical that we acknowledge that, in the final six months of the training period, the UCSF OEM Residency faced the multifaceted challenges of the COVID-19 pandemic. The final section of this 5-Year Progress Report details our successful programmatic responses to this crisis.

Accomplishments over the Project Period

Program Growth

- Leveraged existing NIOSH support through a successful competitive renewal of HRSA training support, beginning in May 2018, for a five-year period.
- Received ACGME approval for a permanent increase from 8 to 9 residency training positions; in 2018, a temporary approval for an increase to 10; and in later 2019, approval to make that permanent.
- Created a new FTE resident stipend equivalent annual support grant from the Kaiser Permanente Foundation, initiated in 2017, that continues to be funded without an end date.
- Identified and implemented mechanisms to increase the ability to utilize VA training support for residents before they initiate or after they cease training grant support.
- Recruited additional military-supported trainees from the Navy and Air Force (6 in the current project period, compared to only one in the previous project period).
- Established (2017) a new faculty, alumni, and other supporter contributed annual fund as a discretionary source of residency support which to date has raised more than $31,000 from 35 distinct donors (some with multiple donations) through the Spring of 2020.
- Upgraded the webpage of the Division of Occupational and Environmental Medicine, including expansion pages devoted to the residency program and including an updated (2019) resident recruitment video (https://oem.ucsf.edu/oem-residency-and-other-educational-programs) to support recruitment, including content highlighting under-represented minorities in medicine.

Program Evaluation

- Formalized and achieved operational excellence for Clinical Competency and Program Evaluation Committees, fulfilling ACGME criteria, while also maintaining an active Residency Advisory Committee.
- Carried out two facilitated faculty retreats for which the residency program was a major focus, including a retreat in 2019 utilizing a "Successes, Weaknesses, Opportunities, and Threats" (SWOT) structure as a lead in to an anticipated ACGME self-study process to begin in 2020.
- Surveyed for the first time (2015) a full roster of program alumni using a structured online questionnaire to obtain programmatic feedback.
- Refined criteria for matriculating selected incoming trainees to 2nd year standing consistent with ACPM criteria promulgated during the current project period.
- Used these criteria to assist recruitment of applicants already board eligible in General Preventive Medicine (four eligible in the current award period, two of whom chose to complete two full years rather than matriculating into the second year).

Program Curriculum

- Converted our CME offering from every 18 months to yearly in March with a consistent location (change initiated just prior to current project period), leading to successful "branding" of the activity.
- Expanded the CME offering to include a poster abstract evening session with a program requirement each OEM resident author on an abstract presentation. For the March 2020 CME, of 21 abstracts 11 were from current residents (including one co-authored with an incoming resident) and one from a recent alumnus (at the 2019 CME, of 22 abstracts, 11 were from current residents, 2 were from former residents, and 2 from current OEM residents from other NIOSH-supported programs (UW and U of I).
- Created an annual newsletter, with content and timing promoting annual CME offering and prominently featuring current and incoming residents and their diversity and accomplishments. https://oem.ucsf.edu/sites/oem.ucsf.edu/files/inline-files/UCSF%20OEM%20Winter%202020%20Newsletter%20Original.pdf
- Transitioned the recommended UC Berkeley (UCB) School of Public Health MPH tract to a highly-student focused Interdisciplinary Tract, thus maximizing curricular flexibility adapted to students' needs. This also obviated the need for diverting trainees from the UCB program to the UCSF one-year Clinical Research Training option, which we had raised as a possibility in the previous competitive renewal.
- Established new training workshops for residents in Emergency Preparedness and in Risk Communication to address identified curricular needs.
- Identified online training options for residents, including Radiation Safety (also addressing a curricular need) and an improved resource for research ethics training.
- Created new Clinical and Non-Clinical Experiential training options by formulating goals and objectives, codifying a Program Letter of Agreement (PLA), and completing a Training Affiliation Agreement (TAA) between UCSF and the proposed site. New training options established during this award period include: the Lawrence Berkeley Lab, Health Services Department; Zenith Insurance; Tom Allems, consultancy; and, most, recently an additional environmentally focused elective rotation at the California-based Center for Environmental Health, emphasizing toxicant exposures in consumer products and related regulations. In addition, the PLA and TAA have been submitted for yet another environmental rotation to being in early 2021 at the Bay Area Air Quality Management District.
- Broadened curricular flexibility beyond the Interdisciplinary MPH so that the program could successfully train incoming residents with a wide range of prior training backgrounds beyond Internal Medicine, Family Medicine, or Preventive Medicine. During the current program period this included: our first pediatrician; a pulmonary critical care trained fellow (to complete in 2021, for whom a special one month pulmonary elective has been developed emphasizing transplant and advanced lung disease); three residents with prior MBAs and particular interest in systems-level health care delivery; and multiple active service military physicians with only one previous year of post-graduate medical training, but with very extensive practical clinical field experience in the military.

- Successfully renewed over two funding cycles our Pediatric Environmental Health Specialty Unit (PEHSU) award (funded by ATSDR and EPA) that provides a valuable experiential learning site for residents, including opportunities for community engagement and outreach.
- Intensified content of the established month-long summer industrial site visit program, including sites featuring a range of industrial processes (sugar refinery, beryllium fabricator, cement quarry, metal foundry, welding operation, industrial scale laundry, vegetable packing, mushroom growing, winery production, glass making, electric car manufacturing, microelectronics manufacturing, biotechnology).
- Also used site visits to address specific content needs in radiation safety (the Stanford Linear Accelerator); risk communication (a local TV newsroom); and emergency preparedness (US EPA emergency response, City and County of San Francisco Department of Public Health outbreak unit, and the Police training unit).
- Carried out our first joint industrial site visits with the University of Utah residency program over the winter break 2016-7 with a second joint site visit (to an underground mine) in the 2019-20 year.
- Introduced an annual thematic focus to the twice monthly OEM Division Grand Rounds presentations: in 2018-19, “vulnerable populations” and in 2019-20, “Toxic Substances & Hazardous Exposures in the Workplace & Environment” (see https://oem.ucsf.edu/residency-and-other-education/occupational-medicine-grand-rounds).

Faculty Development

- Expanded core role for an existing faculty member (Dr. Samuel Goldman) to include coordinating the curriculum of Grand Rounds; taking over as lead faculty for the interdisciplinary (OEM resident and occupational nursing graduates student) toxicology course; joining as a co-course leader of the annual CME offering, and assuming the role of coordinator for resident research, and coming PI for the PEHS grant. This formed the basis for his change in his faculty series to an Academic Senate appointment and advancement to Professor Clinical Medicine (the UCSF prestigious “Clinical X” series).
- Recruited an additional new Employee Health Director at Zuckerberg San Francisco General (ZSFG) (Dr. Chuang, Assistant Clinical Professor), thus strengthening our residency rotation jointly based at the UCSF-ZSFG employee health units.
- Appointed as Assistant Clinical Professor a recent alumna (Dr. Stephanie Holm) to continue her activity in the PEHSU that began as an OEM resident, now an Associate Director of PEHSU, while pursing ongoing doctoral training in epidemiology at UC Berkeley.
- Supported the successful promotion of Carisa Harris-Adamson PhD to the tenured rank of Associate Professor of Medicine in Residence.
- Department of Medicine support underscored by the promotion during the program period of two core faculty (Drs. Blanc and Balmes) to the highly valued rank of Professor 6, which is limited at UCSF to those of international standing.
- Oversaw promotions of multiple long-standing voluntary faculty in recognition of their service to the OEM Division.
- Maintained strong connections with program alumni who have moved on from UCSF to nearby academic institutions (Dr. Durrani at Lawrence Berkeley National Laboratories; Dr. Balogun at the Tang Center, UC Berkeley; and Dr. Puri at Stanford University).

Program Deliverables

- Twenty-six OEM residents enrolled over project period (10 supported by NIOSH).
- Graduated 21 residents to date over the project period (no enrolled resident did not complete; 100% retention).
- Expanded enrollment over project period through leveraged support beyond NIOSH (HRSA, military).

- 14 residents who have graduated since July 2018 have taken and passed the OEM Board examination on the first attempt (four will sit first time, one deferred and one will retake in 2020).
- An additional 10 residents from the *previous* award period have taken and all have passed the OEM Board examination (only one graduate chose not to sit for the examination).
- All trainees have engaged in substantive scholarly and outreach activities (see **Table A**).
- Under-represented minorities in medicine (URM) recruitment improved to 6 of 26 (23%), up from 1 of 11 (9%) in the *previous* award period.
- Diversity by other measures (physical disability, ethnic-religious, Veteran status, active duty military) has been heightened. This has included one asylum refugee and multiple first-generation citizens, including one active duty military from a large Mexican immigrant family.
- The proportion of women (approximately 50%) has been stable compared to the *previous* period.
- Initiated program-supported, occupational medicine resident participation in the annual National Medical Association meeting networking “Paint and Sip” event, distribution of our newsletter.
- Required Program Letters of Affiliation (PLAs) and Training Affiliation Agreements (TAAs) were maintained for all current rotations and submitted and approved for all newly established rotations (12 active clinical and 12 non-clinical experiential learning opportunities).
- Program accreditation has been maintained without any cited ACGME deficiencies and initial steps have already been taken to position the program for the development of its self-study plan (preparation for which was to have begun in April 2020, but which has been deferred by the ACGME due to the COVID-19 pandemic).
- Program Leadership has been stable.
- Program Faculty has been expanded with key new recruitments and academic development benchmarked by successful promotions of existing faculty.

COVID-19 Related Program Initiatives (Relevant to final 6 months of the 5-year award period)

- Program rapidly adapted to remote teaching methods for Grand Rounds, Journal Club, clinical conferences, and core joint MD-Nursing coursework (Winter Quarter, “Occupational Toxicology” and Spring Quarter, “Occupational Health Problems”).
- Rotation reassignments without interruptions for experiential or clinical site opportunities disrupted by COVID-19.
- Introduction of remote care modalities for patient visits in the core interdisciplinary clinic lead by the Associate Program Director.
- UC Berkeley MPH enrolled residents’ adjustment to online only teaching, including allowing for more flexible schedules to increase COVID-19 volunteer engagement (see below),
- Resident involvement in development of study to review stresses on allied health professionals at our public hospital affiliate Employee Health site to identify additional supports needed among employees.
- Resident engagement in the very early COVID-19 response for healthcare workers through Employee Health including exposure assessment, risk stratification, testing, off-work and return to work criteria, and contact tracing. Protocols adapted to emerging information and changing CDC guidelines.
- Resident participation with Program Director and the clinic NP at the VA Hospital in a QI project and manuscript report focusing on use of cycle threshold data from PCR testing to guide return to work.
- Resident-led creation of algorithm (Microsoft Flow/Power) to automate COVID-19 exposure decisions (risk assessment, patient instructions, alerts to clinicians) at the public hospital affiliate Employee Health.
- Two residents assisted Associate Program Director in developing excel spreadsheet tool (“Track-It for COVID”) and the resident protocol for the COVID-19 after-hour hotline (“COVID Hotline Guide”).

Trainee Accomplishments **(**see also **Table A** for full publications and outreach)

Raj Puri, MD MPH (Completed 2016). Currently Clinical Assist Prof of Medicine (Employee Health), Stanford University. Prior to UCSF, three years training in radiology. Scholarly productivity: one paper and two abstracts.
Abdullah Khafagy, MD MPH (Completed 2017). Currently Assist Prof, Umm Al Qura University, Dept. Community Medicine. Prior to UCSF, previously completed FM residency. Supported through educational training support from the Saudi Arabian Ministry of Education. Scholarly productivity: one paper and three abstracts.
Shuchi Agarwal, MD MPH (Completed 2017). Currently Assis Attending Physician, Division of Survivorship and Supportive Care, Memorial Sloan Kettering Cancer Center, NY. Prior to UCSF, PM, Johns Hopkins University. Scholarly productivity: one paper and three abstracts.
Craig Murphy, MD MPH (Completed 2017). Currently Air Force, DOD Aerospace Medicine Liaison in Medical Operations, Johnson Space Center. Scholarly productivity: three abstracts.
Monica (Kaitz) Tilly, MD MPH (Completed 2017). Currently urgent care telemedicine provider, AmWell. Prior to UCSF, completed a UCSF-KP joint PM-IM residency program. Scholarly productivity: one paper and three abstracts.
Erin McLaughlin, MD MPH (Completed 2017). Currently Clinical Assist Prof, Marist College Physician Assistant Studies Program and Lead Physician for Occupational Medicine, Quest Health, New York. Prior to UCSF, completed several years of Radiology training, also undergraduate training in environmental science. Scholarly productivity: two abstracts.
Rahmat Balogun, DO MPH (Completed 2017). Currently staff MD, Tang Center, UC Berkeley. Prior to UCSF, internal medicine residency. Scholarly productivity: one paper and two abstracts.
Miguel Montoyo, MD MPH (Completed 2018). Currently Group Surgeon, U.S. Navy/3rd Marine Aircraft Wing. The son of Mexican immigrants, at UCSF as an active duty Navy medical corps. Scholarly productivity: two abstracts.
Stephanie Holm, MD MPH (Completed 2018). Currently PhD candidate in Epidemiology, UC Berkeley. She came as the program's first Boarded pediatrician. Scholarly productivity: two papers, two book chapters, and four abstracts.
Jeffrey Meade, MD MPH (Completed 2018). Currently serving as a civilian physician at Luke Air Force Base, AZ. He came to UCSF as an active duty Air Force flight surgeon. Scholarly productivity: three abstracts.
Pearlene Lee, MD MPH (Completed 2018). Currently OM physician, NY-NJ Port Authority. She came to UCSF having completed PM at Univ MD, including placement at Federal OSHA in Washington. Scholarly productivity: two abstracts.
Zachary Landman, MD MPH (Completed 2018). Currently Staff Physician, Sports Medicine and Urgent Care, Sutter Health, Walnut Creek, CA. Prior to UCSF, PGY1, orthopedic surgery. Scholarly productivity: one paper, two abstracts.
Sammy Almashat, MD MPH (Completed 2019. Currently OM physician, Dignity Health, CA. Prior to UCSF, Health Research Group (Washington, DC) with PM (Johns Hopkins). Scholarly productivity: two book chapters, two abstracts.
Ben Schanker, MD MPH MBA (Completed 2019). Currently Staff MD, Comprehensive Spine and Sports Center, Modesto, CA. Prior to UCSF, MPH (Johns Hopkins), MBA (Oxford). Scholarly productivity: two papers, seven abstracts.
Josh Potocko, MD MS MPH (Completed 2019). Currently Naval Health Clinic, Quantico, Virginia. Promoted to Lt Commander, in part for his outstanding UCSF performance. Came to UCSF as an active duty (undergraduate, Annapolis; MS, neuroscience). Scholarly productivity: one chapter, three abstracts.
Myles Cope, MD MPH (Completed 2019). Occupational Physician, Workwell, Longmont, Colorado. Prior to UCSF, 10 months of Rehabilitation Medicine, Jefferson Univ. (engage in aggressive program of winter sports rehab for paraplegia, the result of a work-related trench cave-in the summer before starting medical school. Scholarly productivity: three abstracts.
Sarah Johnson, MD MPH (Completed 2020) Physician Executive, WorkCare, Los Angeles, CA. Prior to UCSF, two years of general surgery (U Ill Chicago) then worked as Medical Review Officer. Scholarly productivity: two abstracts.
Nnenna Okoye, MD MPH (Completed 2020). Currently pending clinical position. Prior to UCSF, PGY 1, Adena Health System (Chillicothe, Ohio), including elective time at NIOSH, in Cincinnati. Scholarly productivity: two abstracts.
Michael Shahbaz, MD MPH (Completed 2020) Currently, Assistant Professor, Division of Occupational Medicine and Medical Director, Business Health Icahn School of Med, Mount Sinai, NY, Prior to UCSF, MPH (Sam Jose State) and PGY1 OBGYN (Sunrise Health, Las Vegas). Scholarly productivity: two chapters, one paper, three abstracts.
Robert (Nate) Clapp, MD MPH (Completed 2020) Currently, pending clinical position. U.S. Navy Veteran, boarded in FM, additional training in Emergency and Disaster Management. More than a decade of military clinical experience prior to joining our program. Scholarly productivity: one paper, two abstracts.
The following 5 residents were enrolled in the last program year and will complete in 2021: Sheiphali Gandhi MD MPH; Anthony Pacini MD MPH; Chloe Chien MD MPH MBA; Darren Hall DO MPH; Matt Kiok MD MPH. Collective productivity includes 9 abstract presentations and multiple outreach activities (see **Table A**).

Industrial Hygiene Training Program, UC Berkeley

Background

The UC Berkeley School of Public Health graduate program in Industrial Hygiene trains technical professionals and scientists committed to preventing job-related disease and injury. Industrial hygiene is the science and art of anticipating, recognizing, evaluating, and controlling exposure to harmful agents in the workplace. The goal of the Industrial Hygiene (IH) Program is to educate committed and passionate industrial hygienists with both a firm theoretical background to enable growth and flexibility in our rapidly changing world and a good grasp of the practical aspects of the field to implement this knowledge as practitioners (MS and MPH students) and researchers (doctoral students). The occupational health research conducted by the industrial hygiene group has made profound differences in the lives of workers in industries as diverse as small automobile repair shops to international manufacturers of semiconductors and automobiles, as well as aluminum refining, smelting and fabrication; furthermore, occupational health research has often formed the basis for our understanding and regulation of environmental hazards, e.g., diesel exhaust. This small, focused program provides a thorough, solid theoretical framework complemented by practical application within classes, laboratories, field trips, a twelve-week internship, and a capstone project for MPH students, with in depth research immersion for doctoral students. While retaining the core education for IH, the program is also responsive to changing needs, as evidenced by the introduction of courses in green chemistry four years ago, and global occupational health last year. Each year, 4-8 Masters students and 1-4 doctoral students engage in active learning of industrial hygiene while interacting with the occupational health students in ergonomics, medicine, epidemiology, and nursing as well as the environmental health science and public health students at the SPH.

Accomplishments in Project Period

Starting with the class graduating in 2017, all MPH students in the SPH, including IH MPH students, have been required to complete an Integrated Learning Experience (i.e., capstone or thesis) that demonstrates knowledge, skills and competencies gained in the IH program; this replaces the previous MPH comprehensive exam requirement. Students make an original, substantive contribution to the field, and communicate their integrated learning experience through a series of written, poster, and oral presentations. The capstone/thesis titles for the 16 IH MPH students who graduated in 2017, 2018, 2019, and 2020 follow:

- Characterization and Control of Laboratory Animal Allergens on the UCB Campus
- An IH Perspective in Low-Income Country Garment Industries: An Ethiopian Case Study
- Seasonal Variation of PAH and Oxygenated PAHs Three Cities of California and China
- A UCB Campus-Wide Assessment of Aerosol Organic Solvent Products: The Search for 1-bromopropane
- Injury Experiences of Household Workers in California
- War and Peace of Mind: Work-Related Mental Health Outcomes in Humanitarian Aid Workers
- Analysis of Engineering Controls for Respirable Crystalline Silica
- Measurement of Mercury Exposure in Residential Units and Device Measurement Error, University Village
- Assessing Emissions of 3D Printing Elements in a UC Berkeley Nanotechnology Facility
- Evaluation of Airborne Silica Exposures to Students Building Recreational Boats at UC Berkeley
- Airborne Endotoxin Exposure of a Portable Lavatory Sanitation Worker: A Pilot Study (a thesis)
- Pathogen Exposure from Hand to Face Contact: A Pilot Study Evaluating the Occupational Exposure of a Vacuum Truck Operator (a thesis)
- Gel nail polish as a new source of VOCs in nail salons: An occupational exposure assessment (thesis)
- Proposition 65 and Occupational Exposures: How Consumer Warnings Impact Workers
- Characterization and Control of Occupational Exposures to Benzene and Hydrogen Sulfide in a Petroleum Refinery Process Unit
- Thirdhand Smoke Exposures in Casinos and Other Occupational Settings: Recommendations for Policy Changes and Future Research

Working with our IH advisory committee, we have added a formal course in Global Occupational Health in response to the heightened interest in global environmental health, the great need for work in this area, and the excellent examples presented of IH in action. In 2017-18, we offered an informal seminar series on global occupational health, and in 2018-2019 we offered a formal course in Global Occupational Health, in which we had ten weeks of guest lecturers from occupational health and safety (OHS) experts from around the world to share their experiences in protecting workers and communities from workplace hazards and threats to health; the course was offered again in 2019-2020, and was very well received in both years. All students worked with a grassroots organization in the developing world to conduct research on a specific OHS issue critical to the organization, its members and supporters. Student research projects in 2018 investigated chemical hazards to workers in the electronics and leather tanning industries, ergonomic hazards in garment and electronics plants, and developed training materials for workers in the chemical industry. The students worked with organizations in India, Sri Lanka, the Philippines, Guatemala, and Ethiopia among other countries in Asia, Central American, and Africa. Some of the projects in the spring 2020 course were

- "Health hazards for garbage collectors in Phnom Penh, Cambodia," with the Solidarity Center in Cambodia
- "Health impacts of excessive production quotas for women garment workers in India," with Cividep India
- "Silicosis screening program for stone crushers in India," for Occupational Knowledge International and Jeevan Rekha Parishad in India
- "Silica exposures in the artisanal mining industry in Cameroon," for the Research and Education Centre for Development in Cameroon
- "Health hazards of second-hand smoke in casinos, and examples of smoke-free policies in global casinos," for the Solidarity Center in Cambodia

The course has generated much interest at other universities, and we have been sharing our format and materials with them as they work to offer similar courses. Students gave the course high marks in the evaluation; 6.86 (7point scale) compared to the SPH average of 5.89. Additional comments from the UCB evaluation include:

- "This was the best class I ever took at Berkeley!"
- "The class was very well-though-out and covered a broad range of topics in thorough detail."
- "Easily my most enjoyable course this semester. Glad they decided to create this course."
- "It was great learning about so many different industries and how industrial hygiene principles translate across them. It was also very interesting to have guest speakers who had such impressive experiences to share with us. One of the highlights was Dr. Andi Tenner's talk about her work with Ebola in Africa. The major project was a good way for us to do something tangible and meaningful for a real organization."

Meanwhile, the initiative we started five years ago to include Green Chemistry in the IH curriculum has evolved.

- The principles of green chemistry have been integrated into the IH curriculum in the form of the innovative course "Greener Solutions: A Safer Design Partnership" (PH 271H), which IH students are required to take. *Greener Solutions* is a 3-unit inquiry-based course in which interdisciplinary teams of graduate students (regularly from College of Chemistry, College of Engineering, School of Public Health, and occasionally from the Business School and the Law School) research safer alternatives to hazardous chemicals used in a product or manufacturing process, in response to a specific challenge posed by a partner company.
- Students identify hazards associated with the starting materials, search for safer alternatives through bio-inspired design, and then assess the potential health and environmental hazards associated with each of their proposed alternatives relative to those posed by the chemicals currently used in the application. In doing so, the students learn how the principles of green chemistry can be applied to generate solutions that reduce occupational exposures by employing the highest criteria in the hierarchy of controls—elimination and substitution. In generating a focused alternatives assessment, students consider human health endpoints at all points in the product lifecycle, assess relative exposure potential, and seek systems-level interventions to design safer processes. Exposure assessment, toxicology and sustainability are integrated.
- Many *Greener Solutions* course challenges specifically address occupational exposures, including projects seeking safer alternatives to: formaldehyde-based resins used in permanent-press fabrics, isocyanate-based spray foam insulation, and acrylate-based 3D printing resins.

- *Greener Solutions* has trained 70 graduate students from eight different divisions who have worked on a variety of challenges with partner organizations that range from multinational brands, to start-ups, to a research collaborative and a state regulatory agency. The course has garnered over $300,000 in grant support for curriculum development and instruction.
  Megan Schwarzman, MD, MPH published: Schwarzman MR and Buckley HL. Not Just an Academic Exercise: Systems Thinking Applied to Designing Safer Alternatives (2019) Journal of Chemical Education 96(12): 2984-2992 https://pubs.acs.org/doi/10.1021/acs.jchemed.9b00345#

Program Deliverables

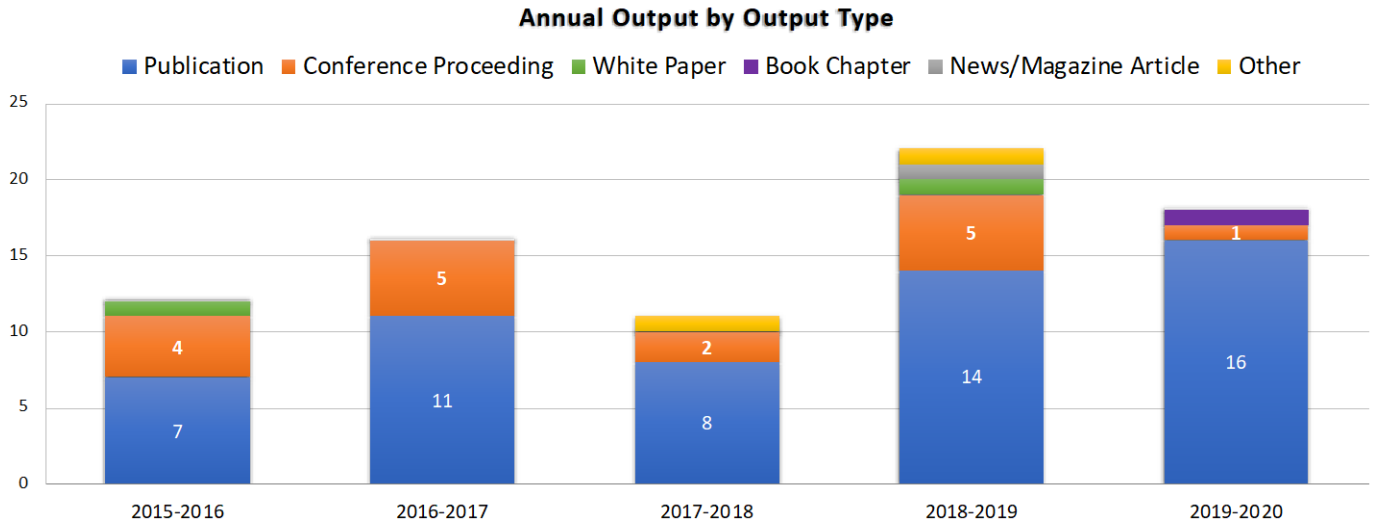
During the NorCal-ERC training grant:

- 18 industrial hygiene masters level students graduated; all are employed or are continuing their studies
- 3 doctoral students in IH graduated
- As described above, we have developed and successfully implemented two new paths for students to participate in the IH program, the 4+1 program for undergraduate public health majors and the OOMPH program, which enables students to take the basic MPH courses online while working, and then to participate in the on campus IH specific courses. The students to date have had excellent experiences with these approaches, and we expect this flexibility will make the program accessible to more students.
- We strengthened our connections between IH students and the Northern California section of the AIHA. Many students attend each section meeting, attend informative talks, and network with experienced IHs. Our recent graduates (Patton Nguyen, Rachel Sklar) have been elected to the board.
- Other practical experiences include a twelve-week summer internship, participating in the occupational health clinics with medical occupational health fellows, visiting workplaces with occupational health nurses and medical fellows, and field assignments, e.g., in ergonomics.
- Most IH students attend the AIHCe, and many present in platform (oral) and poster sessions.
- Occupational and community exposures to wildfire smoke and the consequent health effects were studied by students and faculty:
  - Dr. Kathleen Navarro has published six papers on occupational exposures of wildland firefighters (Drs. Hammond, Noth and Balmes were co-authors on five).
  - She also published two papers on community exposures to wildfire smoke (with Dr. Balmes)
  - Dr. Navarro has worked both as a firefighter and as a risk assessor / risk communicator for the Forest Service since her graduation two years ago.
  - Dr. Navarro began working for NIOSH in fall 2019, and her focus is firefighter exposures
  - Drs. Noth, Navarro & Hammond worked with communities affected by the Napa forest fires in Fall 2017
  - Dr. Noth measured community exposure to wildfire smoke in the Bay Area in fall of 2018
  - Dr. Noth worked with investigators at UCSF to write a research grant to NIH to study the association between pre-term births associated wildfire smoke. The grant, *Wildfires and Intentional Biomass Burning in California and Preterm Birth* (NIEHS R01ES031261), was funded in July 2020.
  - MPH graduate Veronica Ponce de Leon participated in a wildfire health and safety training for day laborers who worked to help clean up and rebuild the areas affected by the 2018 fire. She facilitated sessions on proper personal protective equipment with a focus on respirators and talked about the hazards that may not be visible, but are very much present, such as gases and fine particulate matter.
- Drs. Noth, Liu and Hammond published a series of nine papers on the exposures in the light metal manufacturing industry, and the associated health effects (with Drs. Eisen and Costello).
- Drs. Liu and Hammond published a series of papers on the health effects associated with exposures to metal working fluids; Drs. Eisen, Costello, and Picciotto were co-authors.
- Drs. Hammond and Liu published a series of three papers on the health effects of automotive technician exposures to hexane and other solvents (co-authors Profs. Bates and Eisen).
- Dr. Hammond also published papers related to parental occupation and childhood leukemia, occupational exposure to secondhand tobacco smoke, and firefighters' exposures to flame-retardants.
- Dr. Beverly Shen, who graduated in 2020, has submitted and published IH papers during her time as a trainee:
  - Shen B, Whitehead TP, Gill R, Dhaliwal J, Brown FR, Petreas M, Patton S, Hammond SK.

Organophosphate flame retardants in dust collected from United States fire stations. Environment international 2018; 112:41-8. 10.1016/j.envint.2017.12.009 PMID:29247842

- Dr. Rachel Sklar, who graduated in 2020, has submitted and published IH papers during her time as a trainee:
  - Sklar, R., Zhou, Z.Y., Zalay, M., Muspratt, A., Hammond, S.K., 2019. Occupational Exposure to Endotoxin along a Municipal Scale Fecal Sludge Collection and Resource Recovery Process in Kigali, Rwanda. International Journal of Environmental Research and Public Health 16.
  - Burt, Z., Sklar, R., Murray, A., 2019. Costs and Willingness to Pay for Pit Latrine Emptying Services in Kigali, Rwanda. International Journal of Environmental Research and Public Health 16.
- Dr. Nicas published 4 articles and 1 commentary. He also serves in the following roles:
  - Editor in Chief of the *Journal of Occupational and Environmental Hygiene* (*JOEH)* the leading IH research publication in the U.S. He was a member, from July 2010 through December 2017. He now serves as the Emeritus Editor.
  - Board of Scientific Counselors, National Institute for Occupational Safety and Health, 2016-2018
  - Green Ribbon Science Panel, Department of Toxic Substances Control, CalEPA, 2016-present;
  - Member of the Working Group of the, F23.65 Subcommittee, ASTM F23, for “New Method for Respirator Fit Capability Conformance Test for Half-mask Air-Purifying Particulate Respirators” (formerly ANSI Z88.15)
- Dr. Hammond published 48 peer reviewed scientific papers in the past five years. She also:
  - Serves on the international editorial board of the *Annals of Occupational Hygiene*.
  - Brought an IH perspective to a major study of the health risks and community impacts associated with natural gas storage in California, a study conducted by the California Committee on Science and Technology at the request of Governor Brown; she ensured inclusion of occupational risks in the analyses (910 page report published 2018)
  - Served on an international panel of experts to review over 200 grant proposals submitted to Fundação para a Ciência e a Tecnologia (the Portuguese public agency that supports science, technology and innovation, comparable to the US National Science Foundation) in response to their call for grant proposals addressing forest firefighting and prevention; she was the only occupational health expert on the panel. In addition to intensive review of 26 proposals, she attended the two-day review meeting in Lisbon in 2019, and the three day Zoom meeting in 2020. She was invited specifically to bring the missing occupational health perspective to this meeting, which was chaired by Professor Richard de Neufville of MIT.

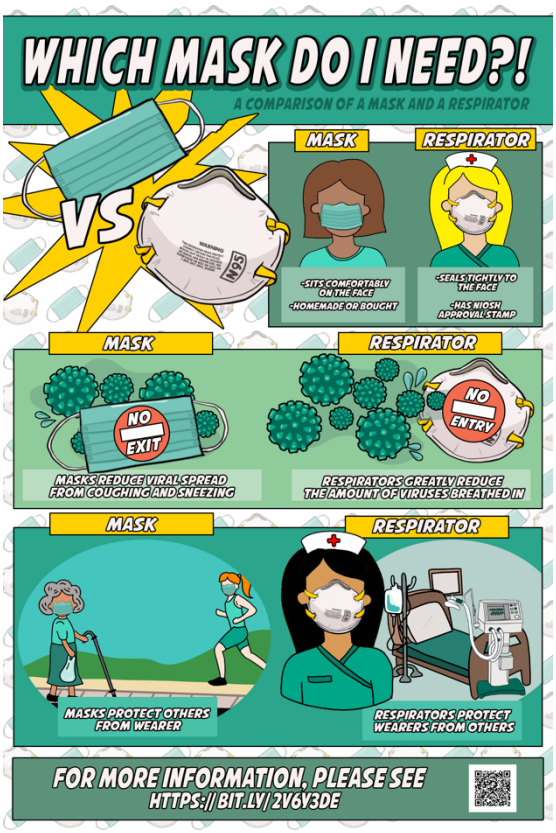
- Over the 5-year period, our program published and presented 17 conference abstracts/presentations, published 58 peer reviewed journal articles, 1 book chapter, and contributed to 6 other types of publications.



- Our program also presented 20 invited talks at academic and industry gatherings.

COVID-19 related Program Initiatives (March 2020-June 2020)

- Educational content rapidly adjusted to support remote teaching methods (less than 24 hours' notice).
- Lab meetings and project meetings quickly transitioned to Zoom conference calls.
- Added new research projects based on local need. Drs. Hammond, Nicas, Noth, Perttula, and Messrs, and Kado, Nguyen, Perrino are measuring aerosol dynamics within campus elevators to understand how long aerosol particles remain in the air in elevators. This work will support development of an interactive decision tree model to inform facilities management decision makers about SARS-CoV-2 exposure reduction.
- Dr. Rachel Sklar is PI on a project looking at the types of health messaging (via text) that drive sanitation uptake behaviors in slums. With the COVID-19 pandemic, she's pivoted that to checking in on people in the same communities for COVID-19. They've also extended services to refugee camps to help provide waste collection and distribute hygiene products.
- David Moore –He has been helping the public health authorities and some private businesses prepare safety protocols for working during the COVID-19 pandemic. In the course of his work, he hired two MPH students in the COEH training program to help him as summer interns.



- Drs. Noth, Hammond, and Ms. Earl created and disseminated an infographic for the general public on use of PPE during the pandemic, titled "Which Mask Do I Need?"

Agricultural Safety and Health Training Program (ASH) UC Davis

Overview

This five-year (July 1, 2015 – June 30, 2020) progress report summarizes the activities of the Agricultural Safety and Health (ASH) training program at UC Davis. The ASH program is a component of the NIOSH-supported ERC, which is within the California state-funded multi-campus Center for Occupational and Environmental Health (COEH).

Agriculture has one of the highest occupational non-fatal injury rates for all industries, and California is no exception. Agriculture, including California's, has one of the highest disabling occupational injury rates and cost among all industries. The alarming statistics on occupational injuries and illness in agriculture highlight the national and regional need for trained professionals in agricultural safety and health trained in identifying, understanding, and abating unique and emerging occupational risks and hazards in agricultural environments. Yet, in the US there are very few academic programs that train doctoral students in agricultural safety and health. This new ASH program is the only one in the state of California to fill this void for the state and Region IX.

The overall goal of the program is to produce effective agricultural safety and health specialists who will serve California, other areas of Region IX, and the United States agriculture. The program's specific objective is to **train a minimum of three doctoral students per year with interdisciplinary skills in agricultural safety and health research and practice**.

During this period, the trainees directly supported by the program have come from doctoral programs in the College of Engineering (Biological Systems Engineering) and School of Medicine (Graduate Program in Epidemiology).The students take a wide variety of courses related to ASH, engineering, public health sciences, toxicology, environmental sciences, research methods, and statistics. Several of the students have also taken professional ERGO online courses offered by COEH-CE in the area of human factors and ergonomics.

This report gives a summary of program accomplishments and outputs. The report also highlights the approach taken to meet the students' academic and research needs during the COVID-19 pandemic.

Accomplishments over the Project Period

The ASH program is relatively new, as it started in the 2015-2016 academic year to support up to three PhD trainees. The first year, there were only two supported trainees; year two, we had three; and years three through five have garnered four trainees. Since most of the trainees are new PhD students, the first two-three years of their program are heavily geared towards taking required courses and exploring research ideas; hence, the accomplishments are less concentrated on the scholarly work, but rather on the academic and outreach side of their program. We observed an increased activity in scholarly publications and presentations in the final year as the advanced trainees have progressed in their research.

Some of our accomplishments throughout the grant period include:

- Successful recruitment of an Assistant Safety and Health Engineering Specialist in Cooperative Extension faculty member (2018). The faculty member has been actively involved in mentoring trainees, including serving on their theses and dissertations.
- Secured another 4 years of funding (2018-2022) for the California AgrAbility Program. The program provides various resources and training to farmers and farmworkers with disabilities on how to stay active in agriculture. The program has opened opportunities for ASH trainees to conduct research on issues facing disabled farmers and farmworkers. All trainees join update meetings of the AgrAbility staff meeting to stay current on all the outreach activities and assist in supporting those activities, such as setting up and manning booths at health fairs or conducting workshops for farmworkers. One trainee,

Lena Nguyen, is currently developing a cart for transporting tomato crates at an organic farm, where several of the workers have been suffering from severe low back pain due to the heavy loads of manually handling multiple tomato crates.

- Trainees attended and participated in several agricultural safety and health workshops, conferences, and symposia
- Creation of a new graduate course in Agricultural Safety and Health (EBS 289C)
- Received funds through the Florida Specialty Crop Block Grant Program (2019-2021) to conduct research on the effects of new compact plasticulture systems in agriculture on workers. ASH trainees will be involved in this project.
- Two trainees, one potential recruit, and an AgrAbility staff member attended the NorCal-ERC's CE Summer Skills Workshop in the HFE Work Simulation Center.
- Received a grant from UC CITRIS and The Banatao Institute through the People and Robots Initiative to explore the effects of exoskeletons in agriculture. ASH trainee Lena Nguyen was directly involved on this small project, where she explored using novel material to construct the exoskeletons. Another trainee, Amjad Ramahi, shared his experience with developing and field-testing agricultural exoskeletons in this project.
- Successfully implemented an annual 3-hour presentation about agricultural ergonomics at the UC Berkeley Occupational Health & Safety Class, including demonstration of field exposure assessment equipment and agricultural interventions and practical solutions.
- One trainee, Alondra Vega, graduated in 2018 and is currently a research associate at the Center for Wellness and Nutrition at the Public Health Institute in California. She focuses on programs that target community improvement in wellness and in health, which include farmworkers and their families.
- Two trainees, Kimberly Prado and Amjad Ramahi, have successfully passed their doctoral Qualifying Exam and have made substantial progress on their doctoral research.

Program Deliverables

- The ASH Training Program has included 21 individuals (17 trainees) over the project period including 7 (41%) undergraduates, 2(12%) Master's students, 8(47%) PhD students, and 4 staff.
- Of the 8 PhD students, 5 were NIOSH ERC funded trainees, 1 of which has graduated.
- The undergraduate students have gained research experience by participating in summer internships and/or semester or yearlong independent studies and are from both engineering and public health backgrounds.
- The program included 17(100%) underrepresented minorities, and 10(59%) females.
- Two visiting scholars from 2 countries visited our program from 1 to 18 months.
- During this period, our trainees (NIOSH & non-NIOSH funded) have worked on 16 different research projects.
- Seven students received additional awards:
    - Two students received small grants from College of Agricultural and Environmental Sciences.
    - Seven trainees received graduate research support from the College of Engineering and the Western Center for Agricultural Safety and Health.
- Trainees have presented eight presentations at several agricultural safety and health conferences and symposia, served on a conference panel, wrote one ASH related online blog, and have published three peer-reviewed papers, along with two recently accepted peer-reviewed publications.

Trainee Mentorship & Program Evaluation

- All trainees have at least bi-weekly meetings with the Program Director to discuss ongoing research and academic work.
- All graduating students meet one-on-one with the Program Director to discuss their experience and future career plans upon exit. Trainees complete an exit survey; in those cases, the survey results are captured by the ASH program.

- All trainees are required to attend the yearly Agricultural Health and Safety Symposium held on campus.
- Biweekly Thursday meetings are held to learn and share student progress and learn about ongoing research projects and any updates about COVID-19 related issues.

Formalized program evaluation has been developed within the Center Wide Administration includes: 1) entering student survey; 2) annual survey that explores students experience with mentorship, curriculum and field experiences; 3) Summer Internship Evaluation; 4) alumni surveys; and 5) key informant interviews.

COVID-19 related Program Initiatives (March 2020 - June 2020)

- Educational content rapidly adjusted to support remote teaching methods
- Lab meetings and bi-weekly project meetings transitioned to Zoom video conferencing
- Trainees attended an online ergonomics workshop given by the Occupational Health lead campus ergonomist on working from home during the era of COVID-19.
- All trainees receive a periodic Safety Update, which includes several items about COVID-19, such as COVID-19 online training on resuming research activities, and a host of resources from campus, the city, Yolo County, Cal-OSHA, CDC, among others.
- One of our trainees, whose wife is a practicing registered nurse, developed an alternative masking system during the mask shortage crisis in March-April, which can be made from household items. The trainee developed a testing system to compare the alternative homemade mask to the N95 mask and has shown that the new mask is comparable to N95 mask performance.
- Modified research activities to accommodate campus rules on conducting research on campus that include social distancing and limited number of people per given area, minimizing contact time, etc.
- Encouraged trainees to spend more time on conducting research online and analyzing and writing research findings.
- Program Director volunteered to review proposals in response to RFA focused on COVID-19 from USDA/NIFA: “Rapid Response to Novel Coronavirus (SARS-CoV-2) Impacts Across Food and Agricultural Systems.”
- Program Director and several trainers were involved in supporting the California-wide COVID-19 Farmworker Study (COFS), which looked at the evidence of California farmworker vulnerability during the COVID-19 pandemic.

NIOSH NorCal-ERC ASH Program Trainee Accomplishments

Trainees During the Program Period	Scholarly Productivity
Amjad Ramahi PhD, a fourth year PhD student, exploring research related to finding means for quantifying epiligament inflammation in the spine due to agricultural stooped postures and finding means to assess recovery from ligamentous injury due to farm labor.	2 Poster Conference Presentation, 1 Abstract, 1 Paper
Vicente Munguia is a third year PhD ASH trainee. This year he completed his required courses related to ASH, and he continues to conduct research on the effect of strawberry harvest aids on the musculoskeletal health of farmworkers, as well as exploring ways of quantifying muscle fatigue during prolonged agricultural work.	2 Poster Presentations
Alondra Vega-Arroyo Completed her dissertation research on assessing clothing as a preventative method for heat illness among California's agricultural workers. Her training support	1 presentation and 2 Journal articles

terminated on December 31, 2017. She is currently a Research Associate at the Public Health Institute, Oakland, CA	
Kimberly Prado is a PhD student in the Epidemiology Graduate Group conducting research on sexual harassment in the agriculture industry. This year, she has successfully passed her doctoral qualifying exam and made substantial progress on her research, including several publications and presentations.	2 Poster Presentations, 1 Accepted Journal, 1 Panel Presentation, and 1 Web Blog
Lena Nguyen is second year PhD student in the Biological Systems Engineering program. Lena completed her required course work for her doctoral program and is currently researching the topic of detecting ligamentous and tendon injuries due to agricultural work using portable ultrasound systems. She has assisted in multiple projects, including assisting in the California AgrAbility program outreach activities.	New Trainee

Accomplishments (Including Non-NIOSH NorCal-ERC funded trainees)

- Between 8-10 students in the program annually (3 funded PhD students annually by NIOSH ERC Training Grant).
- There was a total of 16 individual students trained at the program over the 5-year grant period, 24% (N=5) of which were funded by the NIOSH ERC Training Grant.
- 50% of all students trained in the program are women.
- The five students supported by the NIOSH ERC Training Grant during this period are three women and two men, 4 of whom are URMs. There were three students from Engineering and two from Epidemiology.
- Over the 5-year period, our program published and presented over 30 conference abstracts/presentations, published 25 peer-reviewed journal articles and proceedings, 1 book chapter, and contributed to over 10 magazine or news articles.

Ergonomics Training Program, UCSF, UC Berkeley

Overview

This progress report summarizes the activity of the UC Ergonomics Research and Graduate Training Program (Graduate Training Program) over the period of July 1, 2015 through June 30, 2020. The program is a component of the California state-funded Center for Occupational and Environmental Health (COEH). The Northern California COEH is the multi UC-campus entity within which the NIOSH-supported ERC is based. Over the approximate 30 years since this program was first established, it has provided high quality training for students interested in a Master's or PhD degree in a Human Factors and Ergonomics (HF/E) related discipline. It is only one of 2 programs on the entire west coast that offers PhD training in HF/E; seven of the program graduates have filled faculty positions in ergonomics at other universities. Upon graduation, trainees typically have multiple job offers as consultants, health and safety employees, or HFE Research & Designers in industry, government agencies or academic institutions.

California has led the nation in its ergonomic standards, which, together with the high cost of work-related musculoskeletal disorders, have generated a high demand for professionals and researchers with expertise in HF/E. In response, the mission of our program is to:

1) Develop excellent researchers and designers that will continue to increase our understanding of work-related injuries and further the body of HF/E science and use that information to drive innovation that reduces work-related injuries;
2) Train graduates in HF/E excellence that are effective in reducing the incidence and severity of workplace injuries while optimizing human performance and productivity in the workplace
3) Develop leaders in HF/E that are certified (BCPE) and engaged in driving HF/E excellence and impact.

Our students come to the program from a variety of backgrounds, such as engineering, public health or biology, and the program takes advantage of these differences through interdisciplinary learning experiences. Trainees receive a Master's or PhD degree from UC Berkeley's School of Public Health (Department of Environmental Health Sciences) or from the UC Berkeley College of Engineering (Departments of Mechanical Engineering, Bioengineering or Industrial Engineering). Further, our students take numerous classes with trainees from other programs at COEH, many of whom are also NIOSH ERC trainees, further expanding the interdisciplinary value of the learning experience**. We underscore the vital importance of past, present and future funding from NIOSH**; given the small size of this program and nature of its specialized focus and cross-disciplinary curriculum, **the NIOSH ERC program support provides core funding that substantiates the HF/E program at the UC Berkeley/ UC San Francisco** and allows us to augment program funding from other sources.

This report provides an overview of our accomplishments in terms of program growth, curricular innovation, evaluation and mentoring and output. Given the challenges of training students in this era of COVID-19, this report will also summarize some of the modifications in training and research agendas that have met this new need.

Accomplishments over the Project Period

Program Growth

- Leveraged Occupational Health Internship Program (OHIP) and Short-Term Educational Experiences for Research (STEER) Programs to support 3 undergraduate and 4 graduate summer research internships
- Fifteen visiting student/faculty scholars came to our program providing a unique opportunity for students to discuss international issues, best practices and research. The scholars also provide our

students with important opportunities for collaboration, fellowships and employment around the world.
- Added 2 seasoned consultants to the program who mentor students while providing HF/E services for industry and labor organizations
- Built a new HFE Work Simulation Center providing 1,200 square feet of space includes:
    - simulated concrete grinding station complete with adjustable height ceiling and wall concrete slabs and force plates
    - Packaging and assembly workstations
    - A National Institute of Standards and Technology (NIST) Position and Load Test Apparatus for Exoskeletons (PoLoTAE)
- Launched a Professional 6 class 8-week online ergonomics education course series to increase the level of practice of current practitioners who are not interested in seeking an additional degree but are not qualified for board certification. The courses include: Fundamentals of HF/E (ERG100); Evidence Based HF/E Practice (ERG110); Physical HF/E (ERG120); Cognitive HF/E (ERG130); Prevention through Design (ERG140); Macroergonomics & Systems Approach to HF/E (ERG150)
- Added 5 new faculty to teach online courses, two of which our graduate students take
- Launched a 3-Day Summer Skills Workshop in the HF/E Work Simulation Center to teach graduate students and professionals exposure and risk assessment skills
- Established practitioner internships at UC Berkeley Health & Wellness Center, Lawrence Berkeley Laboratory and Google
- Received gift funds from 7 different companies to support research and training in wearable technology, medical interventions, hand-computer interaction research and computer input devices
- Created a new website and social media marketing campaign to highlight the program, its students and the various opportunities associated with a career in HF/E

Program Curriculum

- Mapped curriculum to the Board of Certified Professional Ergonomists requirements for certification; offer incentive (reimbursement of exam fee) for each trainee to take BCPE within 2 years of graduating (field work needed for certification)
- Added Human Factors in Industrial Design Course (IEOR170) to coursework. Dr. Harris teaches this mixed undergraduate/graduate course.
- Master's/PhD students take 2 of the online courses, Cognitive HFE (ERG130) and Macroergonomics (ERG150) to fill in content gaps, complement internship experiences and provide opportunities for collaboration with practitioners at major companies nationwide (Tesla, PG&E, Kaiser, Boeing, and FDA have all sent HF/E practitioners to our courses)
- Added trainee site visits to include a variety of industries including electric auto manufacturing, Google, winery production, fiberglass construction, and biotechnology
- Improved student training in the area of experimental design and project proposals by adding a small grant proposal requirement to the Ergonomic Seminar Course (PB HLTH 269D) in the fall which is submitted for funding in the spring of the students first year
- The Occupational Health & Safety Class includes an OSHA 30 certification and has expanded to include fieldwork. Each student must visit a job site and discuss safety hazards for that industry as part of the site visit.

Program Deliverables

- The Graduate Training Program has included 44 individuals over the project period including 15 undergraduates, 16 Master's students, 9 PhD students, 3 Residents and 2 post-doctoral students.
- Of the 16 Master's and 9 PhD students, 7 were NIOSH ERC trainees, 4 of which have graduated.
- The undergraduate students have gained research experience by participating in summer internships and/or semester or yearlong independent studies and are from both engineering and public health backgrounds.

- The program included 10 underrepresented minorities, 14 females, 1 veteran and 2 individuals with physical disabilities.
- 13 visiting students and 2 visiting scholars from 5 countries visited our lab for 6 to 24 months.
- During this period, our trainees (NIOSH & Non-NIOSH funded) have worked on 24 different research projects.
- Five students were interns from other Universities as part of OHIP or the STEER Program (an undergraduate summer research internship program, offered through the Environmental Health Sciences Division and NORCAL-ERC).
- Our trainees (NIOSH & Non-NIOSH funded) have won multiple awards at the University of Utah NIOSH Young Investigator Conference, including:
    - In 2018, Vivian Dihn and Aybuke Koyuncu won Best Presentation and Runner Up
    - In 2019, Nathan Poon (NIOSH funded trainee), won Best Presentation for his work assessing the impact of exoskeletons on fatigue
    - In 2020, Mengchang Wang and Federico Arippa won best presentation and best research awards
- Ten students received additional awards including:
    - Three students received small grants for their service or research
    - Seven trainees received research funding through the SCERC Pilot Training Research Program
- Several of the research projects involve important R2P activities. Our program developed and widely disseminated a universal drilling rig to assist construction workers with drilling into concrete and a training video for jackleg drills used in mines (see http://ergo.berkeley.edu/ for details).
- A project on the Ergonomics of Endoscopy led to a training video for Endoscopists used for training and a special journal issue dedicated to the Ergonomics of Endoscopy
- The Professional Program was launched in the 2018-2019 academic year and includes six 8-week online courses that are accelerated semester courses developed for an online platform. Since then, 57 students took between 1 to 6 online ergonomics courses each, and 52students attended the Summer Skills Workshop. In summary, learners accrued 112 certificates and 5,040 contact hours to apply toward their CPE eligibility.
- NORCAL-ERC Ergonomics and Continuing Education Program collaborate with the 18 NIOSH ERCs to launch a monthly webinar series to share and discuss the latest research, policies and best practices in ergonomics. Each monthly webinar has approximately 150 registrants. This program helps to share research and knowledge from the ERCs with practitioners, researchers, students and academics nationally.

Trainee Mentorship & Program Evaluation

- All graduate level trainees have weekly to bi-weekly meetings with Program Director to discuss ongoing research and academic work. Meetings often include co-mentors or faculty from other departments, as applicable.
    - One fall semester meeting explores summer internship and course work
    - One spring semester meeting explores academic year, course work, priorities and curriculum for the following summer/academic year (for returning students)
    - All graduating students meet one-on-one with Program Director to discuss their experience and future career plans upon exit
- Weekly (during COVID-19) to biweekly Monday lab meetings helped to inform all students about logistics, ongoing projects, field trips and opportunities; it also helped to build community across students from different majors and academic backgrounds
- Formalized program evaluation has been developed within the Center Wide Administration includes: 1) entering student survey; 2) annual survey that explores students experience with mentorship, curriculum and field experiences; 3) Summer Internship Evaluation; 4) alumnae surveys; and 5) key informant interviews.

COVID-19 related Program Initiatives (March 2020 - June 2020)

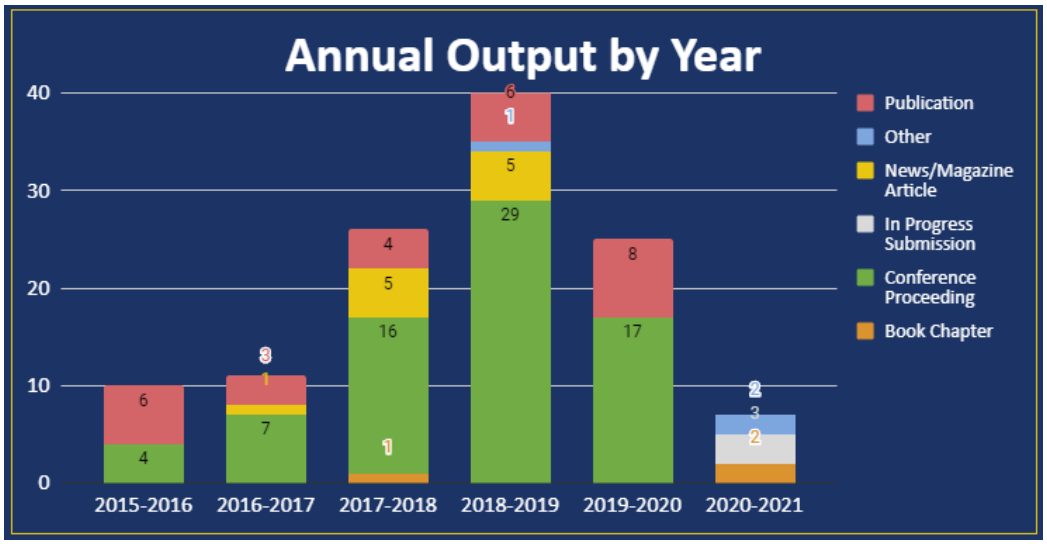
- Educational content rapidly adjusted to support remote teaching methods
- Lab meetings and weekly/bi-weekly project meetings quickly transitioned to Zoom conference calls
- Summer internships were modified to accommodate quarantine; for example, one student provided online ergonomic assessments for a consulting company that focused on working from home
- Consultants, Faculty and Trainees, compiled, posted and distributed:
    - a training video/material for office workers now working from home
    - a training video/material for kids now schooling from home
    - webinars presented to numerous large groups on setting up home offices
    - an interactive 3-part webinar series for elementary school kids on how to comfortably school from home
- Provided multiple interviews with magazines and blogs to support knowledge about computer ergonomics while working from home
- Quickly converted research projects to include COVID-19; for example, a project that was to take place in elementary schools looking at ways to increase posture shifts and physical activity (including use of standing desks) has been modified to accommodate the impact of distance learning on health, wellness and physical activity.
- Added new research projects based on local need. For example, a group of faculty/trainees looked at the impact of COVID-19 on grocery store workers in California by surveying close to 1,400 unionized grocery workers. We have also proposed a project looking at the impact of COVID-19 specific disinfection guidelines on janitors.
- Modified field research to accommodate social distancing. A CPWR funded grant on exoskeletons in construction has been modified to accommodate social distancing by: 1) having surveys be emailed to individuals; 2) inviting only one person at a time to try on exoskeletons in the lab then having an online focus group; and 3) modifying the lab to increase ventilation and add protective barriers between researcher and participant so contact time is minimal (less than 15 minutes)

NIOSH ERC Trainee Accomplishments

Paul Carty, MPH (Completed 2017) Currently a MD resident with Adventist Health serving rural underserved communities. Scholarly productivity: 2 papers
Charles Miller, MPH (Completed 2019) Currently a HF/E Consultant for various office-based companies and industries. Scholarly productivity: 2 papers
Logan Van Engelhoven (Completed 2018) R&D Team for SuitX and works on passive occupational exoskeletons. Scholarly Productivity: two papers (one under review) & four abstracts and three national conference presentations.
Nathan Poon (Completed 2019) Currently a co-founder of Stealth which provides scalable problem-based online education programs. Applies HF/E to the design of online education program. Scholarly Productivity: two papers (one under review), four abstracts, two national conference presentations and one award.
Nancy Gutierrez (Class of 2020) Currently working on “The Application of Exoskeletons in Construction” project. Scholarly Productivity: three abstracts.
Athena Nguyen (Class of 2020) Currently working on “The impact of activity reports and text message cueing on reducing sedentary behavior among office workers during work and leisure time.” Scholarly Productivity: Three abstracts and two papers submitted and awaiting review.
Judith Okoro (Class of 2020) Currently working on “The impact of a systems approach to increasing posture shifts and physical activity among school children while distance learning during COVID-19.”

Program Accomplishments (Including Non-NIOSH funded trainees)

- Between 12-15 students in the lab annually (3 funded annually by NIOSH ERC Training Grant) with an approximate equal division of undergraduate, masters and PhD/Post Doc/OEM Resident students.
- There was a total of 44 individual students trained at the lab over the 5-year grant period, 16% (N=7) of which were funded by the NIOSH ERC Training Grant.
- Although there tend to be more men than women in this program to date, this has shifted in the last year with all 3 NIOSH ERC trainees being female URMs of color.
- There was an approximate equal split of students from engineering and public health departments/majors.
- Over the 5-year period, our program published and presented 73 conference abstracts/presentations, published 27 peer reviewed journal articles, 1 book chapter, and contributed to 11 magazine or news articles



Occupational Epidemiology Training Program UC Berkeley

Overview

This progress report summarizes the activities of the UC Occupational Epidemiology Research and Graduate Training Program over the past five years, from July 1, 2015 through June 30, 2020. The Occupational Epidemiology (OEPI) Program is part of the Environmental Health Sciences (EHS) Division, in the Berkeley School of Public Health. The EHS Division offers the MPH professional degree and the MS and PhD academic degrees. The overall goal is to train future practitioners (MPH and MS students) and researchers (primarily PhD students). For all degree objectives, the curriculum provides fundamental knowledge in toxicology, epidemiology, exposure assessment and control, risk assessment, and biostatistics. The mission of the OEPI is to supplement these EHS fundamentals with an understanding of occupational health in order to provide the background needed to design and implement epidemiologic studies of worker populations. The program is designed to train students to integrate the various EHS disciplines in the conduct of epidemiologic studies designed to identify, characterize, and reduce chemical, physical, and organizational hazards in the workplace.

In addition to the basic concepts and skills required for all epidemiologic studies, occupational epidemiology has its own set of unique challenges. One distinctive aspect is the critical role of exposure assessment. The measurement of current exposures in the work environment usually requires an industrial hygienist. The transformation of measured exposures into an exposure metric for analysis in relation to a health outcome requires further training in exposure assessment for epidemiology. If the outcome is a chronic disease or mortality, an intensive retrospective component may be required to develop a cumulative eposure metric. Collaboration with industrial hygiene students is promoted in several interdisciplinary courses that all trainees are encouraged to take. The other distinctive feature of occupational studies is the healthy worker effect whereby workers more susceptible to the health effects of a specific exposure are likely to try to reduce that exposure either through a job transfer or leaving work. This self-selection bias leads to study populations of active workers composed of survivors. To correctly identify a hazard and accurately estimate an exposure-response relationship requires addressing this inherent potential bias to the null.

Almost all of the trainees in the OEPI program are PhD students. This is because the concepts and skills needed to identify causes of injury and illness due to exposures in the workplace often involve analysis of complex longitudinal data – beyond the training of MPH students. **This NIOSH training grant is critically important in recruiting epidemiology PhD students to the sub-field of occupational epidemiology. Without continued NIOSH support, there would be far fewer occupational epidemiologists in high level positions in governmental and non-governmental organizations or in academic positions in research universities.**

This report provides a summary of our recent successes in 1) recruiting the highest caliber students into the program, including those from under-represented populations, 2) providing a research environment that fosters productivity during the training program, and 3) their subsequent success after they graduate.

Program Deliverables

- The OEPI training program has included 13 ERC trainees over the past five years. All 13 were PhD students in either Environmental Health Sciences (6), Epidemiology (4), or Biostatistics (3).

- Among the 13, 15% (2) were from underrepresented minorities (Ferguson and Garcia), 2 were first generation college graduates (Beckman and Garcia), and 77% (10) were women.

- To date, 7 of the 13 trainees have graduated. Of the 7, 4 are pursuing academic careers and 3 are employed as researchers;

    - Erika Garcia (2017) was just appointed Assistant Professor in the Division of Environmental health of the Department of Preventive Medicine in the Keck School of Medicine at the University of Southern California (USC), after having spent the past 2 years as a post-doctoral

fellow in that department. Her doctoral work focused on identifying the presence of healthy worker survivor effect using a path analysis of a directed acyclic graph and estimating exposure-response for female breast cancer among autoworkers exposed to metalworking fluids. Since graduation she has shifted to studies of the benefits of reducing air pollution on childrens' lung function.

- Jackie Ferguson (2019) is in a joint post-doctoral program between Stanford and the VA in Palo Alto. Her dissertation was on the health effects of shift work in a cohort of aluminum manufacturing workers. Since graduation she has shifted to studying disparities in outcomes of COVID-19 by race and ethnicity among veterans.
- Jonathan Levy (2019) is a Statistical Scientist at Genentech working on new estimators leveraging machine learning. As a trainee he worked on the data analysis of a longitudinal study of air pollution and pulmonary function among Latinx children in Fresno, CA.
- Holly Elser (2019) is in an MD-PhD program and is now completing her MD at Stanford. As a medical student she has continued her research in occupational epidemiology and is currently leading an analysis of ischemic stroke mortality in relation to metalworking fluid exposure among UAW-GM autoworkers.
- Stella Beckman (2016) is a data analyst at the California Cancer Prevention Center (affiliated with UCSF). Her dissertation included studies of COPD mortality and metalworking fluid exposure in autoworkers and color vision defects in a cohort of Bay Area automotive mechanics potentially exposed to hexane.
- Monika Izano (2017) is a post-doctoral research fellow at Kaiser Permenente Northern California Division of Research. Her dissertation involved a novel approach to addressing left truncation bias, due to later start of cancer incidence follow-up (Michigan Cancer Registry) in the larger cohort mortality study of UAW-GM workers.

- Our trainees have won several prizes and awards.
  - Two of them were awarded Best Student Presentation at EPICOH in 2018 (Ferguson and Elser) for a co-authored study of shiftwork and depression among aluminum manufacturing workers.
  - Elser also received a prestigious NIH F31 award for her studies of workplace gender composition and mental health outcomes in a cohort of aluminum manufacturing workers.

- During this period the OEPI program included two post-doctoral fellows in occupational and environmental epidemiology. Both were awarded NIH K99/00 grants and now have faculty appointments as Assistant Professors - Andreas Neophytou in Epidemiology at Colorado State and Joan Casey in Environmental Health Sciences at Columbia.

- Several trainees have given webinars and presentations at COEH symposia. Erika Garcia presented her work on healthy worker survivor bias and Jackie Ferguson presented the development of new exposure metrics for shift work.

Program Curriculum

- We were able to reschedule the Occupational and Environmental Epidemiology course (PH254) so that the OEM residents would regularly be able to take the course, along with trainees in IH and Ergonomics. This contributes to the interdisiplinary collaborations so critical to occupational epidemiology and the NorCal-ERC.

Trainee Mentorship and Program Evaluation

- There are regular weekly meetings of the occupational epidemiology research group. These meetings are chaired by the Program Director and include researchers (Costello and Picciotto), staff data analysts (Lutzker and Chen), post-doctoral fellows, and trainees.

- All trainees meet with their academic advisors at least bi-weekly to discuss their research. They also meet at least quarterly with the Program Director to review their progress through the program.

- Formalized program evaluation has been developed within the Center Wide Administration includes: 1) entering student survey; 2) annual survey that explores students experience with mentorship, curriculum and field experiences; 3) Summer Internship Evaluation; 4) alumnae surveys; and 5) key informant interviews.

NIOSH ERC Trainee Accomplishments

- The OEPI trainees have been co-authors on 41 papers published in peer-reviewed journals over the past five years. Because PhD students become more productive in the later years of their training, there has been a steady increase in publications over the five-year period: 2 papers in 2015-16, 1 paper in 2016-17, 5 papers in 2017-18, 10 papers in 2018-19, and 23 peer-reviewed papers in 2019-20. Some of highlights from these papers include:

    - Erika Garcia's descriptive analysis of changes in the concentration of metalworking fluid exposure from 1940 to 1995 across the three plants included in the UAW-GM cohort study. These graphs have been included in several papers we have published on cancer in that cohort, specifically Garcia et al, "Breast Cancer Incidence and Metalworking Fluid Exposure in a Cohort of Female Autoworkers" (2017) and Izano et al, "Contrasting Causal effects of alternative workplace interventions" (2018).

    - Garcia also published a path analysis (2017) to investigate whether healthy worker survivor effect was operating in her studies of female breast cancer and lung cancer. She found HWSE was not present in the breast cancer study (2017). She found HWSE was present, however, in the lung cancer study and so she applied g-computation to reduce the bias (2018).

    - Holly Elser's (formerly Stewart) work on mental health outcomes in relation to gender composition and layoffs. In her first thesis paper (2019), she reported higher rates of treatment for depression among both men and women in plants with a smaller proportion of female employees. In her second paper (2019), she applied a quasi-experimental approach (difference-in-differences) and found increased rates of depression in relation to periodic layoffs among the aluminum manufacturing workers who remained employed.

    - Jackie Fergusons's groundbreaking studies of shiftwork in which she meticulously coded detailed patterns of shiftwork in a large cohort of aluminum manufacturing workers at multiple US sites, over time. She developed a set of novel metrics of forward and backward rotation, and night work, and examined the health effects associated with these shiftwork patterns, and with changing shifts in a series of papers, beginning with "Night and rotational work exposure within the last 12 months and risk of incident hypertension" (2019). Other papers will be forthcoming.

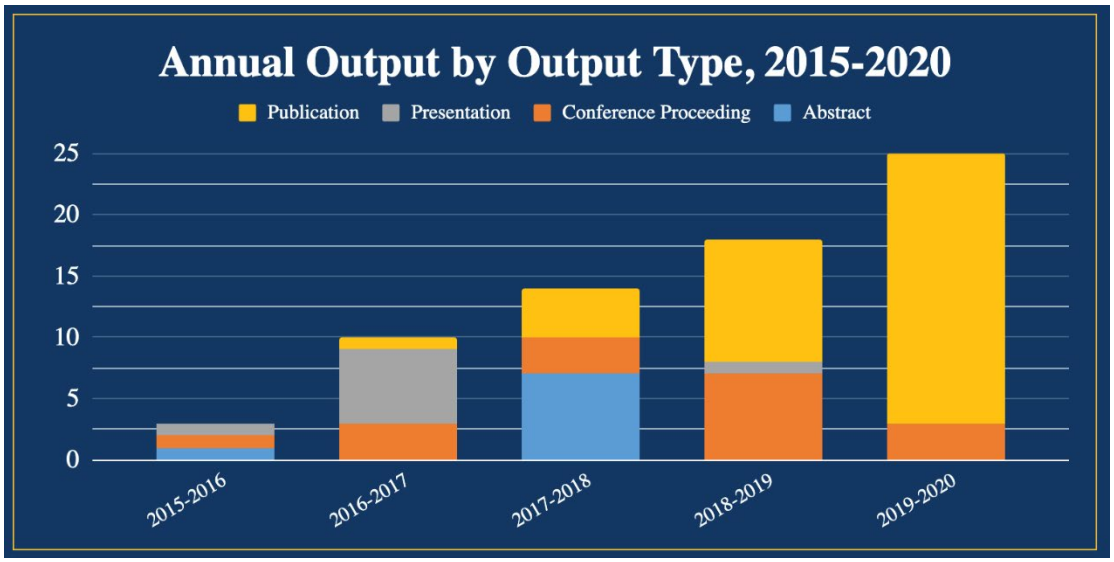
- Trainees have presented their research a total of 33 times at epidemiologic conferences, mostly EPICOH, SER or ISEE, over the past five years: 3 in 2015-16, 9 in 2016-17, 10 in 2017-18, 8 in 2018-19, and 3 in 2019-20.

COVID-19 Response

When shelter-in-place orders were initiated in the Bay Area on March 12, trainee mentorship and research continued, despite the pandemic. We were about halfway through the semester at that time and so we immediately switched the format of our course, Occupational and Environmental Epidemiology, from in-person to remote via zoom. The students were already comfortable with the format of the weekly review of a paper from the literature where students are randomly called on to answer questions in the structured critique. Thus, the transition from in-person to remote class went relatively smoothly for these weekly discussions. The final projects, however, posed more of a challenge. The small group assignments for the final projects had to be restructured to accommodate the potential absence of the five occupational medicine residents in the class

who anticipated being called back to clinical service. Each project focused on a controversial topic involving a specific occupational or environmental hazard and involved contrasting two epidemiology papers. The students had to quickly learn how to use zoom for small group meetings to prepare for the oral presentations of these final projects. Despite challenges, the quality of the presentations was good, overall.

Sadie Costello collaborated with Carisa Harris-Adamson in mentoring an occupational medicine resident to develop and analyze data from a survey of approximately 10,000 essential grocery store workers regarding their experience with workplace infection control measures and customer harassment. As follow-up to that study, Dr. Costello is leading an effort to apply to NIH for an R01 to expand the grocery store study into a longitudinal study of COVID-19 in several cohorts of essential unionized workers in California, potentially including janitors, meat packing, and nursing home staff, as well as grocery store workers.



Targeted Research Training Program, UCSF & UC Berkeley

Overview

This report summarizes the activities and accomplishments of the NIOSH-funded Targeted Research Training (TRT) Program (PI: Prof. Michael N. Bates), based at the University of California, Berkeley (UCB), but including students from the University of California, San Francisco (UCSF).

The Northern California Education and Research Center (NorCal-ERC) has a long history of research productivity, of both faculty and trainees. The NorCal-ERC is housed within the Northern California Center for Occupational and Environmental Health (COEH) which currently has over 50 faculty from multiple disciplines, including agricultural engineering, bioengineering, biostatistics, epidemiology, ergonomics, exposure assessment, lung biology, occupational health nursing, occupational and environmental medicine, sociology, and toxicology, whose research is well funded through extramural support. The NorCal-ERC has three core training programs, - industrial hygiene, occupational health nursing, occupational medicine - and three allied programs; ergonomics, occupational epidemiology, and agriculture safety and health. In 2008, the Targeted Research Training (TRT) Program was added to provide a more integrated and interdisciplinary approach to research training. The TRT Program has been continuously funded since then, with Prof. Michael Bates, environmental and occupational epidemiologist in the UC Berkeley School of Public Health, as TRT Program Director since 2013. This report covers the most recent 5 years of funding.

A key intention of our TRT training program is interdisciplinary research training. To achieve this during the years after its inception, the TRT program originally focused on 6 thematic areas that represented strengths of our faculty and were considered to provide good opportunities for Research to Practice (r2p) projects.

Although the TRT Program generally worked well during those years, two key limitations emerged: (1) the number of thematic areas were too many and their scope too broad to focus and encourage a relatively small number of trainees to work together in a multidisciplinary way; (2) although TRT funded students for the period of their research training, it provided no funds for actually carrying out the research. This proved a hindrance, particularly since the usual period of TRT funding—one year—was generally insufficient for both raising adequate funding and carrying out the research. When Dr Bates became TRT Program Director, he refocused and strengthened the interdisciplinary training component of the TRT. Key features were:

1. The focus areas for interdisciplinary research training were reduced from six to two, representing research strengths of faculty from both Berkeley and San Francisco campuses. They were 1) occupational health and safety of firefighters; and 2) occupational health and safety of automotive and automotive repair workers. However, early experience taught us to de-emphasize these indicated preferences, so as not to exclude from consideration particularly meritorious project proposals that deal with other topics that fit into the National Occupational Research Agenda (NORA).

2. Each TRT applicant was required to submit a research proposal in the format of an NIH small grant proposal (i.e., R03), including a budget. Submission of a joint proposal in conjunction with another student from another TRT program was encouraged but was by no means required. Again, experience showed that joint proposals were very rare, and we came to treat them as acceptable, but not expected.

3. Applications for TRT traineeships, including research proposals, had a submission deadline to the TRT Program Director by July 31 of each year. Applicants were limited to those completing doctoral degrees or occupational and environmental residents; students doing master's degrees were not admitted.

4. As Director of the Northern California COEH, Dr. John Balmes, agreed, subject to an acceptable project budget accompanying the application and availability of funds, to make available research funds for successful grant proposals, originally with a maximum amount of $7,500 per person; but this was reduced to $4,000 in the last few years of the grant, because of a reduction in available COEH funding. This amount was provided by COEH administration and was awarded one time only to a successful applicant, but not again if they received subsequent years of TRT funding. The funding was intended primarily for purchase of supplies and equipment, payment of field staff, and travel, but not for student stipends or tuition, as these were provided by the TRT program fund.

5. The students carried out the research, under mentor supervision. They were expected to produce one or more manuscripts for publication in peer-reviewed journals.

6. Subject to satisfactory progress, doctoral students were encouraged to reapply for TRT funding. The reapplication was required to contain a research progress report.

Training in Research Methods - Interdisciplinary Research Seminar

The only curricular element common to all TRT- supported students, and not part of the curriculum of the core programs was the Interdisciplinary Research Seminar, which, since 2008, has been conducted by Dr. Michael Bates, the TRT Director for the 2015-20 period. This seminar addressed a need for interdisciplinary research training for TRT students. The seminar is intended both to provide practical training in research methods and to give students an opportunity to present their own work in progress and receive feedback.

The seminar met monthly, either at UC Berkeley or at UCSF, for two hours throughout the academic year. Although all NorCal-ERC trainees were invited, in recent years it has been run in conjunction with the NorCal-ERC's Occupational Health Nursing Program, based at UCSF. Travel by public transport is direct and easy between the two campuses.

The seminar has the following objectives: 1) to introduce students to the inherently interdisciplinary nature of occupational health research; 2) to give students the opportunity to develop presentation skills and have their research project plans and progress critiqued; and 3) to teach students about relevant research methods to which they will usually not have been exposed in their coursework.

Over the years, the optimal monthly seminar schedule has evolved. It presently involves approximately alternating sessions in which the TRT trainees present the current state of their research to each other and the TRT Director and sessions in which there is a presentation, by either Dr. Bates or an invited presenter, of some aspect of research methods training. The TRT trainee presentation seminars provided an opportunity for the trainees to learn from each other and to receive feedback from Dr. Bates. The trainees also had the opportunity to meet separately with Dr. Bates to discuss aspects of their research requiring more in-depth consideration.

The alternate research training seminars, which were conducted jointly with the OEHN Program, involve interactive presentations on aspects of research usually covered only superficially in standard academic courses. These included, for example, calculation of power and sample size, questionnaire design and administration, obtaining IRB approval for research projects, handling of missing data, and accessing disease registries and other existing data sources. Some of these seminar topics "recycled" every few years, depending on the expressed needs of current trainees.

Trainees (07/01/2015-06/30/2020)

During the 5 years of funding, the TRT Program had 9 trainees, 6 of whom graduated with their PhDs by the end of the funding period. The trainees were:

Erika Garcia, Epidemiology. Graduated PhD, 2017. (TRT funding 2015-2017) (URM: Latina).

Dr. Garcia's dissertation project investigated the association between metalworking fluid exposure and breast cancer incidence among a cohort of occupationally exposed women. Metalworking fluids (MWF) are coolants and lubricants used in industrial machining and grinding operations. The study's objective was to examine the exposure-response relation between breast cancer incidence and cumulative exposure to straight and synthetic MWF among a cohort of occupationally exposed female autoworkers. To accomplish this, data were used from the United Autoworkers-General Motors (UAW-GM) cohort, a large occupational cohort of hourly workers in automotive manufacturing with extensive exposure information and nearly three decades of cancer follow-up. The trainee estimated the exposure-response relationship using Cox proportional hazards models on the female cohort members, including the 221 incident breast cancer cases, to examine the risk of female breast cancer incidence associated with MWF exposure.

Stephanie Phelps, OEHN. Graduated PhD, 2016. (TRT funding 2015-16):

For her research, Dr. Phelps studied hearing loss, tinnitus and occupational injuries among career firefighters. 249 firefighters from Texas and California participated in a cross-sectional, internet-based survey.

Occupational injury (within the past 12 months) and auditory function information was collected via self-report. Audiogram results were obtained from the firefighters' medical charts. Data collection included information about personal factors, organizational and environmental factors, and auditory function obtained through online self-report surveys. The study results suggested that age, occupational stress, and tinnitus are risk factors for occupational injury among firefighters.

Kathleen Navarro, Industrial Hygiene. Graduated PhD, 2017. (TRT funding 2012-17) (URM: Latina):

Dr. Navarro's dissertation combined traditional methods of exposure assessment with new approaches to evaluate, in ambient community and occupational settings, exposures to air contaminants commonly emitted from wildfires. First, she examined air quality impacts from a mega-wildfire in California and demonstrated the unique application of intake fraction to emissions-to-exposure for wildfires. This emphasized that air quality impacts are not localized only to communities near large fires but can extend long distances and impact larger urban areas. Dr. Navarro also characterized polycyclic aromatic hydrocarbon (PAH) exposures for wildland firefighter performing various job tasks on wildland and prescribed fires. Lastly, she evaluated predictors of urinary PAH concentrations in the National Health and Nutrition Examination Survey (NHANES), 2001–2006participants from a variety of sources, including demographic information, food intake, housing characteristics, and modeled outdoor air pollutant exposures. To complete her dissertation research, she became qualified as a wildland firefighter. This allowed her to obtain high-quality personal and area exposure data, and to understand the environment and workplace factors that influence exposures for wildland firefighters.

Eunice Lee, Epidemiology. Graduated PhD, 2016. (TRT funding 2014-16)

For her dissertation, Dr. Lee studied long-term effects of air pollutants on chromosome telomere length in children, as a biomarker of oxidative stress in immune cells. She hypothesized that air pollution affects telomere length of white blood cells, which in turn increases susceptibility to adverse health effects via immune response. She obtained blood samples for telomere analysis from the ongoing Children's Health and Air Pollution Study-San Joaquin Valley (CHAPS). She also investigated whether ambient noise (traffic, airport and trains) acted as an effect modifier of the health effects of the air pollution.

Jessica Trowbridge, Epidemiology PhD candidate. Graduated PhD, 2020. (TRT Funding 2015-20) (URM: Latina).

This was a community based participatory biomonitoring research project looking at occupational exposures to environmental chemicals linked to breast cancer among female firefighters compared to non-firefighter controls. Occupational studies have found firefighters are at risk for different types of cancers, and firefighter organizations in the US have raised concerns about elevated rates of premenopausal breast cancer among women firefighters. San Francisco, California has one of the largest forces of women firefighters in the country (>250 women), making it an ideal location to understand exposure to compounds with potential links to breast cancer.

Rachel Sklar, Industrial Hygiene PhD Candidate. Graduated PhD, 2020. (TRT funding 2017-20) (URM: Filipina/Pacific Islander).

Ms. Sklar studied microbial risks associated with occupational exposure during municipal co-digestion of food wastes and sewage sludge. The growing pressures of water scarcity and the lack of clean and sustainable energy have led to increasing numbers of waste to energy systems for treating sewage waste. At the same time, efforts to recycle food waste that use anaerobic digesters to convert the food into biogas are growing nationwide. Co-digestion is the process in which the feedstock from different waste streams, including municipal food waste and sewage, are mixed together and anaerobically digested. This process converts organic municipal solids, food waste, and sewage sludge into a profitable resource such as compost or biogas. In this way, municipalities have the opportunity to reduce their dependence on fossil fuel energy sources. This study characterized the occupational health risks associated with inhaled and ingested microbial exposures for workers at each stage in the municipal co-digestion process.

Debra Hemmerle, Occupational Health Nursing PhD Candidate. (TRT funding: 2017-2019)

Ms. Hemmerle is studying post-concussive symptoms and delayed return to work in adults following mild traumatic brain injury. This research project involves a secondary analysis of a prospective cohort study to evaluate the relationship between post-concussive symptoms and delayed return to work in adults following mild traumatic brain injury (TBI). About 75% of all TBIs are designated as mild; however, current classification methods fail to adequately capture the severity of symptomatology within a mild TBI diagnosis. Prior research has shown that varying levels of affective, somatic, and/or cognitive impairments – called post-concussive symptoms (PCS) can remain in place for weeks to years. Studies have shown that these invisible and often undiagnosed PCS contribute to impaired work performance, higher rates of suicide, substance abuse, and loss of previous employment. The research objective is to promote occupational success by determining which mild TBI survivors have a higher likelihood of delayed return to work, identifying their post-injury vocational needs, and exploring which survivors may benefit from greater resource allocation or formal vocational rehabilitation.

Michael Kado, Industrial Hygiene PhD Candidate. (TRT funding 2019-20)

The focus of this exposure assessment research is the carpet recycling industry, which has been little investigated. The project will be the first to identify job tasks and characterize airborne occupational exposures to particulate matter and associated toxic compounds in the expanding carpet recycling industry in California. Identifying and characterizing each task performed during carpet recycling is vital to understanding the air concentration to which workers are exposed to toxic compounds. Mitigation strategies can then be developed. The objectives of this study are in accordance with NORA objectives which seek to understand and reduce lung disease in emerging manufacturing sectors.

Rachel Odes, Occupational Health Nursing PhD Candidate. (TRT funding: 2019-2020)

Workplace violence in health care settings is increasingly recognized as a costly and pervasive problem. The National Institute for Occupational Safety & Health's National Occupational Research Agenda for Healthcare and Social Assistance, released in February 2019, identified as its Objective 3: "Investigate the epidemiology of workplace violence in health care and identify effective strategies for prevention and mitigation." Ms. Odes' research aims to improve understanding of workplace violence in hospitals and engage frontline staff in attempts to improve safety in their workplaces. The working hypothesis is that an intervention targeting frontline staff will improve the reporting of incidents within healthcare facilities. In addition, providing staff members the necessary information to formulate potential solutions to address unsafe conditions in their workplaces will help identify strategies for prevention and mitigation.

Trainee Accomplishments

During the 2015-2020 grant period, the trainees were productive with regards to publication in peer reviewed journals, conference presentations and earning recognition through awards. Overall, the trainees:

Produced 13 published articles in the peer-reviewed literature

- Presented 9 presentations on their work at research conferences
- Won 3 student awards including:
    - Erika Garcia won the University of California's M. Donald Whorton Writing Award, for 2017
    - Kathleen Navarro won both the Best Student Poster at both the 2016 American Industrial Hygiene Association, Environmental Issues Committee and the 2016 American Industrial Hygiene Association, Incident Preparedness Response Working Group

COVID-19 Response

We are pleased to report that we were able to transition smoothly to an online platform and that there were no major COVID-19-related disruptions to the training or mentorship of the four TRT students. Two students, Rachel Sklar and Jessica Trowbridge, were able to transition to online mentorship as they finished their dissertations (RS filed in the spring and JT intends to file during Fall semester 2020). The two students who are earlier in their research training successfully modified their research plans in response to COVID-19. Rachel Odes modified her research plan in response to avoid in-person contact with health care personnel who are at risk of workplace violence. She pivoted to focusing on hospital employees' experiences of implementing California's new workplace violence regulation. She now plans to use mixed methods to better

understand hospital reporting practices and improve utilization of the California State Workplace Violent Incident Reporting System for Hospitals. Michael Kado also modified his aims to avoid in-person sampling at carpet recycling facilities. He now plans to simulate the recycling process in the lab and sample for ingested and inhaled exposures during the simulation.

Outreach Program (Labor Occupational Health Program) UC Berkeley

A. PROGRESS REPORT

Over the last 5 years, the Labor Occupational Health Program (LOHP) helped to implement the NorCal-ERC's broad outreach goals, including:

- Connecting NorCal-ERC resources with OS&H practitioners in the field, including labor, business and OH professionals, to increase their capacity to participate in promoting effective injury and illness prevention programs in the workplace
- Promoting the integration of OH&S into curricula at the high school, community college and university levels
- Helping to provide community-based internships and community engagement opportunities to undergraduate and graduate students
- Building a network among faculty and OH practitioners within Region IX to share resources, research results and promote research to practice (R2P)

A.1 Impacting OH practitioners in the field

a. *Outreach/Partnerships with Practitioners in Labor and Community Organizations*

In the last 5 years, LOHP has reached approximately 1,500 individuals a year through a variety of programs targeting workers in a range of industries, including construction, healthcare, retail, schools, nail salons, hotels, janitorial, hotel and hospitality, domestic work, childcare centers, recycling and food processing. As many attendees of our programs go on to share information and resources with their constituencies, we estimate many more are reached through our work. Programs are designed to provide workers with the leadership skills to take an active role in promoting and implementing effective injury and illness prevention programs in the workplace, and have been conducted in partnership with unions, community groups and employers. Many of these programs are conducted within Worker Occupational Safety and Health Training and Education Program (WOSHTEP), which is a statewide training initiative designed to train worker leaders and others to address health and safety on the job. The WOSHTEP program is delivered statewide in collaboration with UCLA Labor Occupational Safety and Health Program (LOSH) and the Western Center for Agricultural Health and Safety at UC Davis. Trainees have been reached through several additional programs, including:

- Our School Action for Safety and Health (SASH) program, which targets school programs;
- Our Labor Employment Task Force Training and Outreach program, which targets workers in the underground economy and the community groups who represent them;
- Our OSHA Harwood Training grants, in which we have partnered with the UniteHERE, the Service Employees International Union, the State Building and Construction Trades Council, ILWU Warehouse Union, Local 6, United Food and Commercial Workers Union and others to provide training to immigrant workers and other vulnerable populations in hotels, janitorial companies, recycling, landscaping, construction, and other industries.

LOHP has also provided training to hazardous waste workers and community residents living near refineries through the Western Region Universities Consortium (WRUC), funded by The National Institute of Environmental Health Sciences (NIEHS). This consortium includes UCLA Labor Occupational Safety and Health Program (LOSH) as lead agency, University of CA Davis Extension (UCDE), Arizona State University Polytechnic Campus Environmental Technology and Emergency Management Group (ASU) and University of Washington's Northwest Center for Occupational Health and Safety (UW).

In this period, we developed training in a number of new areas to respond to emerging issues and needs among our target population. These include:

- A training program about sexual harassment and assault prevention for workers and supervisors in the janitorial industry that has become a model for the state of California;
- A training about climate change for union leaders;
- A heat illness prevention program for community health promotors and workers in agriculture and landscaping construction, delivered in Spanish and several indigenous Mexican languages;

- Training and materials for day laborers and agriculture workers impacted by recent devastating wildfires, covering such issues as clean up and exposure to wildfire smoke; and
- A training in environmental justice for community residents and workers living adjacent to the Chevron oil refinery, a project that came out of LOHP's work from 2013 to 2016 facilitating a community collaborative on Refiner Safety and Community Health, set up after an explosion in 2012.
- A community based participatory research partnership with the California Nail Salon Collaborative focusing on capturing workers experience with breast cancer and its potential association with chemical exposure at work. This project involved conducting interviews with workers and owners and will result in a training program to build worker leadership in addressing toxic chemicals in the workplace.

b. *Outreach/Partnerships with Practicing Professionals, Professional Organizations and ERC Faculty*

During this period, LOHP collaborated with OHS professionals and professional organizations, including the California Industrial Hygiene Association, state and local health departments, Cal/OSHA, and health care clinicians in a number of our training programs, frequently in partnership with COEH's CE program. Examples of programs targeting OH professionals include training for nurses and other health care workers in workplace violence prevention, training for OH professionals on developing effective training programs, training for Cal/OSHA inspectors on assessing training effectiveness, training for researchers on developing research to practice (r2p) plans. Over the last two years, we have begun working closely with faculty from the UCSF Occupational Medicine program to provide a one-month placement to OH medicine residents to give them exposure to LOHP's outreach and training activities. LOHP also participates annually in the American Public Health Association conference in November, presenting papers on our work to public health professionals across the nation. We have regularly collaborated with the NorCal-ERC CE program to develop and implement webinars on a range of subjects.

LOHP also coordinates the California Partnership for Young Worker Health and Safety, a statewide working group that brings together state agencies to develop policy and educational strategies for improving young worker health and safety, such as:

- The Department of Education;
- Cal/OSHA;
- the Labor Commissioner's Office;
- the Occupational Health Branch; and
- Other organizations representing teachers, occupational health professionals, parents, and youth employment programs.

Policy efforts have focused on strategies to institutionalize health and safety training for high school students in work-based learning programs. Locally, partners have also succeeded in establishing requirements for youth to receive health and safety information when they apply for their work permits. In FY 18-19, two new projects emerged from this partnership. We are collaborating with industrial hygiene staff at the Occupational Health Branch to develop, pilot test, revise, and make available two new tools to support workforce development programs, with a focus on Career Technical Education (CTE) in school settings and community pre-apprenticeship programs. Second, the California Department of Education has funded LOHP to conduct workshops on effective methods to deliver health and safety training to students, geared toward high school teachers in a variety of work-based learning programs, including programs for young adults with learning and cognitive disabilities.

c. Outreach/Partnerships with Practitioners in the Business/Employer Community

LOHP reaches approximately 200 employers a year in training programs designed to increase their ability to comply with the requirements of California's IIPP standard. Over the past three years, we initiated a special focus on reaching temporary worker agencies and have partnered with American Staffing Agencies to deliver training to staffing agencies on their health and safety responsibilities. In developing and implementing these programs, we have partnered with Cal/OSHA, State Compensation Insurance Fund, the Department of Public Health's Occupational Health Branch, the California Industrial Hygiene Association, Small Business California and California Small Business Association.

A.2 Integrating Occupational Safety and Health into Existing Curricula

a. Curriculum Development

LOHP and NIOSH collaborated to update LOHP's Staying Safe at Work curriculum for teaching workers with developmental disabilities about workplace safety. This curriculum was adapted for national distribution in 2016 and is now being used by employers, school districts and state agencies around the country. Each year, LOHP conducts two-day occupational safety and health training programs for members of Source America, a federal non-profit organization that serves employers of people with disabilities. These trainings include instruction on how to use the Staying Safe at Work curriculum to teach their employees with disabilities basic occupational safety and health skills.

b. Workforce Development

Over the last several years, LOHP began a new initiative to reach out to workforce development and apprenticeship programs to encourage them to include training on basic health and safety competencies in their existing training programs. From 2014 to 2017, as part of a 3-year NIOSH funded study, LOHP developed the construction-specific guide, *Your Construction Safety Program: Safe Students, Safe Workers*, to provide tools and best practice guidelines for integrating occupational health and safety training into construction apprenticeship programs. From 2018 to 2019, we have expanded this effort to reach Career Technical Education (CTE) Programs in a range of industries, including auto repair, agriculture, and logistics and warehousing. In collaboration with the Occupational Health Branch at the CA Department of Public Health, LOHP revised the construction-specific guide for use in CTE programs and developed lesson plans for effectively teaching OSH problem-solving skills for workforce development programs, including CTE and other pre-apprenticeship programs. In 2019 to 20 we continued to build partnerships with participants in the state funded program 'High Road Training Partnerships', which funds unions and other groups to develop and implement high quality workforce development partnerships. With the assistance of the California Labor Federation, we have been able to disseminate our materials and message that highlight the critical role of building health and safety competencies into programs. Several HRTP's are now including LOHP in their plans for future funding to expand this work.

c. Reaching Undergraduates/Graduate-Level Students at UC Berkeley and Other Institutions

Over the last four years, LOHP staff made numerous classroom presentations for graduates and undergraduates at a variety of institutions, including UC Berkeley, UCSF School of Nursing, UC Davis, Merritt College in Oakland, Northern Arizona University, and University of Nevada in Reno. We met our goal to conduct at least 10 presentations each year. In 2014, LOHP developed a School of Public Health (SPH) course for matriculated in-person learners, *Social Justice and Worker Health*, which has been delivered every other year and reaches approximately 16 students per class, including graduate students and undergraduates from a variety of campus departments, including public health, sociology, city and regional planning, and ethnic studies.

d. Outreach/Awareness Seminars for High School Students

LOHP has continued to coordinate the Young Worker Leadership Academy, a program that brings teams of youth throughout the state to UC Berkeley to spend three days learning about occupational health and planning community outreach programs designed to raise awareness about young workers' health and safety. This program also serves to introduce teens to public health and occupational health careers. These participants then reach out to hundreds of other youth through their community activities in May. LOHP also coordinates a local Teens Lead @ Work (TL@W) peer leadership program in partnership with the City of Berkeley YouthWorks, and recently the City of Richmond YouthWorks. Through TL@W, we train peer leaders who in turn train approximately 300 other teen workers on health and safety issues during the spring and summer. Each year, LOHP staff also provides training to an average of 100 youth educators and teachers at various conferences, who are then able to reach hundreds of high school students. In addition, we continue to integrate youth voice into our annual "Safe Jobs for Youth" month public awareness campaign, including an annual high school poster contest, which promotes workplace safety and rights on the job.

As described above, in 2018-2019 LOHP deepened its partnership with the California Department of Education, which provided funding for 12 3-6 hour workshops on the NIOSH Youth@Work curriculum (which

LOHP previously helped develop), reaching over 270 work-based learning instructors throughout California, who will in turn reach thousands of high school students.

A.3 Providing Occupational Health Internships

Since 2015, LOHP has continued to serve as the Bay Area site coordinator for the Occupational Health Internship Program (OHIP). OHIP is a full time, paid summer internship designed to link the skills and interests of undergraduate and graduate students with the needs of workers employed in underserved or high-hazard jobs. Each year, depending on available funding, LOHP hosts up to 4 teams in the Bay Area, placing them with such organizations as the State Building Trades, the Amalgamated Transit Union, UAW, Street Level Workers Center and UniteHERE. Each project focuses on an aspect of research to practice, including participatory research and promotion of evidence-based practice. Interns conduct research, prepare a report and develop 'give-back' products for their host organizations, such as trainings, videos and other learning materials.

A.4 Promoting a Regional Network

Over the last four years, LOHP has continued to promote the sharing of resources, educational materials and research reports and results among faculty and other constituencies throughout Region IX. Activities have included:

- Conducting surveys of faculty and other stakeholders in the region to identify needs and preferred networking strategies;
- Identifying opportunities to provide training or resources to practitioners throughout the region;
- Featuring outreach and research to practice efforts in COEH publications and newsletters;
- Developing and disseminating an R2P roadmap that can be used by researchers to plan their R2P strategies; and
- Working with existing networks maintained by the Western States Occupational Network (WestON).

WestON includes participants from 19 western states that are working in occupational safety and health. WestON was established in 2008 to help build state-based OSH capacity in the West. Participants work in health departments, academic institutions, NIOSH-funded agricultural centers and Education and Research Centers (ERCs), state and federal government agencies, and other organizations. LOHP staff sits on the planning committee for, and has presented at, the WestON's annual conference.

COVID-19 Response

In the last 5 months, LOHP has responded to the COVID-19 pandemic in a range of ways. During this period, LOHP partnered with several COEH SPH faculty to conduct research into the impact of COVID-19 on grocery workers. In partnership with UFCW, the union representing these workers, the research team developed and launched an online survey distributed to over 20,000 workers. Findings are being analyzed and will be shared both with UFCW, policy makers and in peer reviewed journal. LOHP is also participating in a research team developing a survey of workplace exposures to be implemented to participants in COVID-19 testing in the Fruitvale, a low-income neighborhood in Oakland.

We have developed over 20 trainings and webinars targeted to 'essential workers', including janitors, domestic workers, airport workers, retail, hotel workers and delivery workers. Many of these were delivered in English and Spanish and reached close to 2,000 workers and organizations. We also developed written material for restaurant workers and janitors. In addition, we have created and maintained a resource guide on LOHP's website that captures information relevant to low wage workers in essential industries and includes industry specific guidelines, factsheets, webinars and other resource materials. https://lohp.berkeley.edu/covid-19-worker-resources/. Finally, we have been part of a number of state wide networks of unions, worker centers and community groups who have been meeting to identify needs faced by the workers they represent and identify policy strategies, including improvement in leave benefits, stronger anti-retaliation measures protecting vulnerable workers reporting hazards or becoming sick, stronger and more strategic enforcement of health and safety regulations and new strategies to engage public health departments in implementing public health ordinances relating to COVID-19. The LOHP director, Laura Stock, has presented on the connection between COVID-19 and workplace at several meetings of regional city council and public health staff including the Bay Area Regional Health Iniquities Initiative, BAARHI, and with staff of the City of Oakland mayor's office. LOHP

will be participating in ongoing discussions about ways to improve education, outreach and enforcement at the local and county level. Ms Stock is also a member of the CalOSHA Standards board which recently voted to initiate rulemaking on a new emergency COVID-19 regulation that would cover all industries in California.

Continuing Education Program, UC Berkeley

A. Progress Report

A.1 Background

The Northern California ERC was established in 1982 and Continuing Education has been a vital component of the ERC since its founding. CE promotes health and safety in workplaces and communities by:

- *Educating* health professionals in epidemiology, ergonomics, industrial hygiene, medicine, nursing, toxicology, and related fields to be leaders in occupational and environmental health
- *Advancing the knowledge* of practicing health and safety professionals by offering short occupational and environmental health and safety continuing education courses
- *Offering continuing medical education* courses that are developed and evaluated by a standing NorCal-ERC Continuing Medical Education Committee
- *Responding to the needs* of people affected by hazards in their workplaces or communities, with special attention to vulnerable populations

These goals are enacted through Continuing Education activities (such as symposia, hands-on workshops, online courses, and webinars) designed to provide skills-based training and increase professional certifications, and to create lasting impact, such as reduced occupational illness and injuries, and reduced morbidity and mortality.

CE has hosted *281 courses* from FY 15-16 to FY 19-20*, serving 13,655 learners* with *61,619 total person-hours of training*. Through our free online webinar series, CE has actively worked to increase course accessibility and the number of non-profit course learners, which has *grown by 312%* from FY 16-17 to FY 19-20. Online webinars have also provided remote training opportunities, increased outreach to Region IX, and enhanced program visibility and awareness of NorCal-ERC as a resource for practitioners, employers, and labor organizations.

During FY 19-20, CE hosted 59 courses and served 5,207 learners, a *152% growth* in annual learners across the grant period. Program learners also include NorCal-ERC NIOSH trainees, who are encouraged to attend CE events and frequently offered scholarship seats and program discounts to facilitate increased engagement, providing opportunities to network with professionals from a variety of disciplines. Courses were made possible via collaborations across NorCal-ERC campuses, in coordination with state agencies including the California Department of Industrial Relations (DIR), and through partnerships with NIOSH ERC Continuing Education programs throughout the country. CE hosted 27 free webinars that reached 47 states and 35 non-US countries in FY 19-20, with 57% of learners who reported state data located in Region IX. In addition to learners who participate live, the majority of webinar recordings are made available for free on YouTube. Online recordings on this platform accounted for 887 hours of watch time in FY 19-20, a *220% growth* from FY 18-19. More than 90 health and safety experts participated in an instructional capacity during FY 18-19, sharing knowledge from academic settings, state agencies, and private practice. On average, 78 individuals participate as instructors, presenters, and/or speakers during CE courses annually.

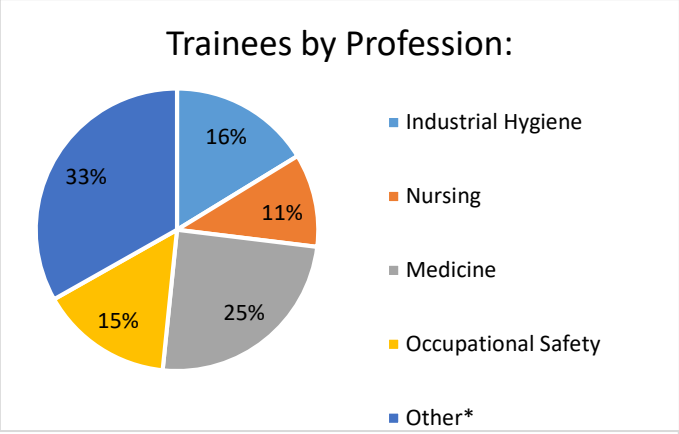
CE continues to have favorable feedback from learners, with an average of 69% of evaluation respondents indicating they are somewhat to very likely to change their practice as a result of courses. More detailed evaluation feedback can be found in *Section A.3 Program Deliverables.*

CE Program Course Summary							
	Total # Courses	Total # Trainees	Contact Hours	Total Person-Hours	In-Person	Online	Webinars
2015/2016	95	2,064	891	17,613	93	2	0
2016/2017	56	2,119	449	14,023	48	3	5
2017/2018	20	906	105	5,079	9	0	11
2018/2019	51	3,359	475	12,915	24	11	16

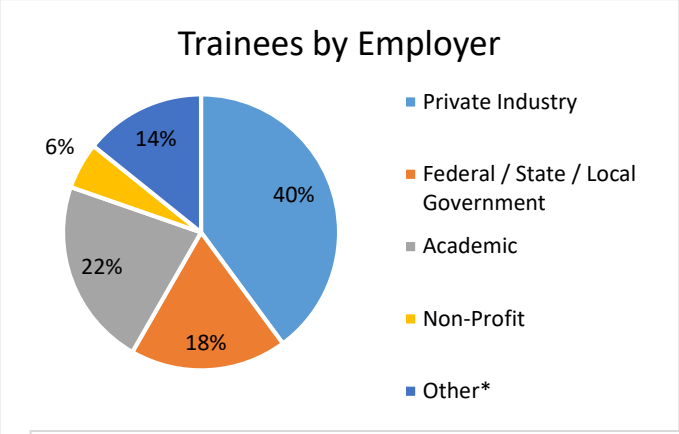
2019/2020	59	5,207	412	11,989	18	14	27
Total	281	13,655	2,332	61,619	192	30	59

A.2 Past Performance / Accomplishments

A leading accomplishment of CE has been the growth of our year-long Online Human Factors and Ergonomics (HF/E) Training Program, hosted in cooperation with the UC Ergonomics Research & Graduate Training Program. This program includes six eight-week courses, designed specifically to prepare individuals for certification from the Board of Certified Professional Ergonomists (BCPE). CPE certification is the gold standard ergonomics certification in the United States and matches globally set certification requirements suggested by the International Ergonomics Association. Many ergonomic practitioners come with graduate degrees from other related fields (e.g. Physical Therapy,



*Other learners include Ergonomists, Epidemiologists, Toxicologists, Physical and Occupational Therapists, Agricultural Workers, Chiropractors, Acupuncturists, Psychologists, Human Resource Managers, First-Responders, Research Scientists, Insurers, and more



*Other employers may include volunteer organizations, contract workers, unemployed workers, unreported employers, foreign employers, and more

Occupational Therapy), yet lack HF/E specific training. This course series fills that gap and provides education in core competencies required for BCPE certification. The online courses are rigorous and analogous to a semester course at the University and are complemented by a Summer Skills Learning Lab that provides hands-on training for exposure measurement, risk assessment, and design. Demonstration job tasks are mocked up in our new HF/E Work Simulation Center, and attendees are able to gain hands-on practice and apply materials learned through attending the online courses.

During the first year of the program, FY 18-19, the Online HF/E Program provided training to 62 learners, solidified relationships with 6 core instructors, and served as an additional revenue source for the CE and Ergonomics Programs. Revenue was reinvested to sponsor two summer work stipends for ergonomic students, and to provide full and partial scholarships to 10 individual learners, including three NIOSH trainees. In FY 19-20, the program grew by *82%*, with 113 participants and full or partial scholarships provided to 14 learners.

CE also facilitated the launch of the ERC Ergonomics Webinar Series in February 2019 and the ERC Industrial Hygiene Webinar Series in February 2020 and continues to serve as host for both. These new webinar series have provided free educational resources to 2,137 learners in cooperation with 12 ERCs and facilitates access to NIOSH ERC supported research. CE continues to collaborate with California's Department of Workers' Compensation, California's State Compensation Insurance Fund, and the Office of Environmental Health Hazard Assessment to review and provide Continuing Medical Education (CME) and Board of Registered Nursing (BRN) credit for six online courses:

- Evaluating California's Injured Workers: Qualified Medical Evaluators (QME)
- Medical Treatment Utilization Schedule (MTUS)
- Acute Pain Management

- Chronic Pain Management
- Recognition, Management, and Reporting of Pesticide Illness
- California Medical Supervision Program for Physicians Who Supervise Workers Exposed to Cholinesterase-Inhibiting Pesticides

CE also worked with California's Department of Industrial Relations to offer five-day, in-person courses on Fundamentals of Industrial Hygiene; and two-day courses on Occupational Noise, Noise Measurement, and Noise Control for Cal/OSHA employees. These courses included hands-on learning labs on how to use monitoring equipment to increase the competency and confidence of learners in the field.

CE is actively incorporating "flip the classroom" as an approach to learning. This model encourages learners to gain first exposure to new material outside of the classroom, usually via reading or lecture videos, and devotes subsequent classroom time to higher-level cognitive work, such as the assimilation of knowledge through application, problem solving, and discussion. CE's purchase of an online learning management system has provided an opportunity to incorporate this style of education more comprehensively, with the use of the Richmond Field Station as a training lab for hands-on practice. This model was tested and proven successful via the Online HF/E Program, which is complimented by an annual hands-on workshop to facilitate learning through practice and is being expanded to include topics in Industrial Hygiene and Occupational Safety.

Through our free online webinars, strategic partnerships, and other efforts to increase NorCal-ERC's reach and visibility, our email subscriber list has grown from 2,330 subscribers in June 2018 to 7,856 subscribers in June 2020, with *409% overall growth* since 2015.

A.3 Program Deliverables

During the past five years, CE has undergone significant restructuring to better meet the needs of practitioners. For example, CE ceased regular Lead and Asbestos courses in December 2016 (offered by multiple alternate providers in Region IX) to reinvigorate CE's commitment to providing education on emerging occupational and environmental health topics, new research, government standards, and legislative updates. In FY 15-16, the Lead and Asbestos program accounted for 54% of CE content, but only served 30% of learners. In FY 16-17, the program accounted for 35% of classes offered, but only served 15% of learners. Although the cessation of the Lead and Asbestos programs reduced the total person hours of training from FY 15-16 through FY 19-20, the reattribution of resources provided an opportunity to develop educational content in alternate disciplines and to grow the scope of educational activities provided by the CE program. CE has seen an increase in the total number of learners served through shorter learning activities (such as free webinars) and will leverage new engagement to increase participation in more intensive in-person and online trainings in Industrial Hygiene, Occupational Safety, the intersection of Health and Agriculture, and more. Serving a growing audience and accessing new markets remains a strategic priority of CE, and was exemplified through courses such as *The Buzz on Cannabis: Health and Safety in the Workplace*, *Health from the Soil Up: Bridging the Silos of Health and Agriculture*, and *Violence Prevention in the Healthcare Workplace*.

From FY 15-16 to FY 19-20, CE hosted 59 one-hour webinars, reaching 5,149 learners and providing education on topics such as beryllium health effects on workers, lithium as a novel occupational hazard, training workers with intellectual disabilities on health and safety on the job, occupational epidemiology and the healthy worker effect, and more. These webinars are made possible through collaboration with NorCal-ERC academic departments, the Interdisciplinary Center for Healthy Workplaces, Labor Occupational Health Program (LOHP), NIOSH ERCs, and partnerships with professional work groups, universities, private and other non-profit organizations. The webinar learner base has grown tremendously since inception in 2017, from 250 participants in FY 16-17, to 3,438 participants in FY 19-20 (*a 1,275% growth*). CE also waived the cost for certificates of completion for webinars in January 2019 to provide free CEUs to qualified learners and provided 1,109 free CEUs for webinars in FY 19-20.

In-person courses served 4,940 learners and online courses (not including webinars) served 3,566 learners from FY 15-16 to FY 19-20. These online courses, made possible through partnerships with state agencies, academic departments, and access to new, online educational tools, increase the accessibility of continuing education for learners who may not have the time or resources to travel to in-person course offerings.

All CE courses are evaluated and reviewed following the activity, and impacts are assessed through learner surveys and regular meetings with advisory members. The average survey response rate was 52% throughout the grant period. The average response to the question, 'How would you rate this course overall?' remained consistent throughout the grant period, averaging 3.5 for in-person courses. The average response to the question, 'How well did this course meet the stated objectives?' was 3.4, and the average response to the question, 'How useful was this course?' was 3.3 for in-person courses. Responses were weighted on a scale of 1 – 4, with 1 being "Poor," and 4 being "Excellent."

CE program courses are designed to improve competency, promote worker health and safety, and to address emerging issues in occupational and environmental health. In FY 17-18, the question, 'How likely are you to change your work practice as a result of this course?' was introduced to evaluations. For *in-person courses*, 68% of respondents reported they are somewhat (37%) to very likely (31%) to change their work practice. For *webinars*, an average of 70% of respondents reported they are somewhat (41%) to very likely (29%) to change their work practice.

All course evaluations delivered consistently throughout the year query learners, "What topics would you like to see addressed in future CE webinars, symposia, or courses?" This data is summarized, reviewed, and shared with course directors and advisory committees annually to inform future course development, and to generate course content through identifying professional practice gaps and educational needs. CE also participated in the generation and distribution of the 2017 National CE Needs Assessment, which was designed to determine national training and education needs and preferences of Occupational Safety and Health (OSH) and associated professions. Region IX data was extracted from this assessment to identify learner needs specific to Region IX.

A.4 Ongoing Projects

In addition to efforts previously outlined, CE has identified and is actively developing new educational content and initiatives including:

- An expansion of the pilot HF/E scholarship program, to include a minimum of 3 partial or full scholarship seats at all CE courses as a standard model of participation to enhance access for low-wage workers, worker representatives, and community group members who may not have as many resources available to obtain CEUs.
- Identification of collaborators and augmented curriculum to increase competence in core educational areas required for CIH certification. Online content will be supplemented by in-person courses at the Richmond Field Station, where learners will apply knowledge through hands-on experience with monitoring equipment.
- Flip the classroom and hands-on safety course development on topics including Lock Out Tag Out, Ladder Safety, Fall Prevention, and Electrical Safety designed for Certified Safety Professionals and others in need of safety cross-training.
- Online and in-person symposia geared toward actively increasing representation and inclusion efforts for underrepresented minorities in Occupational and Environmental Health and Safety (OEHS). An annual event will include panels, research presentations, workshops, and breakout sessions as training tools to connect various demographics with OEHS professionals and academic programs. This initiative comes as a continuation of the commitment of our program to provide quality training, access, and representation for all.

COVID-19 Response

In response to the COVID-19 pandemic, CE reviewed and aggregated resources to support NorCal-ERC administration and facilitate the launch of NorCal-ERC COVID-19 Resources and Information webpages. CE also partnered with the Labor Occupational Health Program (LOHP) and UC Ergonomics Research & Graduate Training Program to generate free webinars on *Protecting Workers in the Service Industry during the Coronavirus Pandemic* in both English and Spanish, and *Ergonomic Tips for Working and Schooling at Home*

during COVID-19. CE convened an advisory group with representatives from government, academia, and private practice to develop three online, asynchronous courses on working safely and reducing risk during the COVID-19 pandemic, scheduled for release in 2020. Although some in-person, hands-on workshops were cancelled as a result of COVID-19, CE's expertise in online course development and webinar hosting proved essential in the rapid transition to online learning. In addition to supporting NorCal-ERC faculty and staff, CE also participated in information sharing sessions with multiple partners to provide feedback and guidance on software, best-practices, and lessons-learned in support of the national effort to transition to remote work and learning.

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