FINAL PROGRESS REPORT

Purdue University
School of Health Sciences
West Lafayette, IN 47907

Project Title: Occupational Safety and Health Training Grant

Total Project Period: July 1, 2001- June 30, 2006

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ABSTRACT

The Purdue University Graduate Program in Industrial Hygiene, which offers programs at both the masters and doctoral levels, developed considerably in the past grant period. The overall goals of the program are to prepare students for advanced careers in Industrial Hygiene and Occupational Safety and Health, to contribute to the regional and national pool of highly skilled professionals in these fields, and to provide research and service in solving occupational health problems. During the period of performance of this grant the program added faculty, made innovative changes in the curriculum, internationalized its research effort and initiated several new faculty-student research projects. The program renewed its accreditation from the Accreditation Board for Engineering and Technology (ABET). The faculty continued to be productive in research and publications. Both faculty and students received numerous awards for academic accomplishments during this period.

SUMMARY OF SIGNIFICANT FINDINGS AND DEVELOPMENTS

During the last project period, there was considerable progress and enhancement of the academic and research aspects of the Graduate Program in Industrial Hygiene. Highlights of the progress during the project period are listed below and described in more detail in the pages that follow:

- Several new courses introduced in the last project period were formally approved by the University.
- A new introductory course in Occupational and Environmental Health Sciences was created based on a revision of the previous introductory industrial hygiene course.
- There were course innovations in several courses.
- The core faculty was expanded to five full time core faculty with the addition of a second toxicologist
- The Graduate Program in Industrial Hygiene renamed and reconstituted as the Graduate Program in **Occupational and Environmental Health Sciences**.
- The international research activities of the students and faculty were expanded.
- The program continued to provide assistance on occupational safety and health problems to local and regional industry and government.
- Numerous student awards were received.
- There were new faculty awards and professional achievements
- The program was reaccredited by ABET
- The program collaborated with University of Cincinnati and other regional occupational safety and health academic programs in a NIOSH funded program to fund pilot research projects.
- The faculty participated in University interdisciplinary activities related to Public Health and Environmental Science

PROGRESS REPORT

Curriculum Innovations

1. Four new courses, introduced on an experimental basis in the previous grant period were formally approved by the Purdue Graduate School. These courses are:

i. Health Sciences 580: Occupational Ergonomics
ii. Health Sciences 581: Applied Occupational Ergonomics
iii. Health Sciences 582: Video Exposure Monitoring Methods
iv. Health Sciences 546: Advanced Topics in Ventilation and Control Technology

2. The introductory Industrial Hygiene course HSCI 345. which is taken by graduate students without previous background in Occupational Health has changed its name to "Introduction to Occupational and Environmental Health Sciences". This reflects a growing interplay between occupational and environmental health activities of industrial hygienists and an awareness of the intellectual cross-fertilization of many concepts common to assessing hazards in occupational and community environments. Drs. Rosenthal and Zimmerman have developed a revised curriculum for this course to reflect these changes.

3. HSCI 547 Epidemiology - To provide "hands on" experience in analyzing epidemiological data, Dr. Rosenthal has created population simulation software. The software embeds exposure response relationships in the population data, which are then investigated by the students with a variety of study designs. The software was first used in Fall 2003.

4. HSCI 552 Introduction to Aerosol Science –Two new laboratory exercises have been introduced in this course. a) a competition between two lab groups to determine the physical characteristics of an unknown aerosol, b) an instructional/research experience in which students study the particle size dependence of real time aerosol instrumentation.

5. In 2005, field exposure assessment exercises were introduced into HSCI 551 Health Effects of Nonionizing Radiation. Initially the following projects were undertaken: a. RF exposures from an AM transmitting tower, b. UV exposures in a tanning salon, c. optical hazards of laser pointers. Dr. Rosenthal also arranged a field visit with a member of the Purdue Department of Radiological and Environmental Management in which they assessed exposures due to emissions of emergency response and communications antenna.

Expansion of Core faculty

Dr. Zheng was added to the core faculty in 2003. He is a neurotoxicologist who conducts studies in environmental and occupational toxicology. He is currently working with a new NIOSH trainee, Dallas Cowan, in planning a study of manganese exposure and its effects in smelter workers.

Revision of the name and structure of the graduate program

The graduate program in Industrial Hygiene was reconstituted as the Graduate Program in "Occupational and Environmental Health Sciences". This was done to reflect: 1) the growing interplay of environmental and occupational health problems and the need to train professions to be able to address this interplay, 2) the expanding research interests of the faculty in environmental health problems, 3) the great overlap of concepts and methods between occupational and

environmental health and 4) the interest of prospective students in environmental topics and issues. At the master's level, the graduate program in Occupation and Environmental has three tracks: a) occupational health, b) environmental health, and c) ergonomics. The occupational health track would have a core curriculum similar to the existing industrial hygiene core curriculum. We are currently considering reducing the core requirements for Ph.D. students in order to make possible more specialized programs oriented to their areas of research. These changes in part reflect the diverse areas of study that are already present in the program; however, they are also meant to make that breadth more explicit and to serve to create more interest in the program for prospective students.

International Activities

The faculty and students of the program have become increasingly involved in international activities. In 2005, Drs. Zheng and Rosenthal initiated a study in collaboration with the Zunyi Medical College in China, to investigate manganese intoxication and neurophysiologic effects in smelter workers in Guizhou province. Dallas Cowan, a NIOSH trainee, is actively engaged in this study. Dr. Zimmerman has participated in several international conferences on indoor air pollution and has presented his work with NIOSH trainee, Hernando Perez

Assistance to local and regional industry

Technical assistance was provided to local companies through the Purdue Technical Assistance Program (Drs. Zimmerman and McGlothlin) and with student projects in courses (Dr. McGlothlin). The student projects have worked with the following companies: Siemens, Wabash National, ALCOA, TRW (Fairfield), Indiana Veterans Home. Also, Dr. McGlothlin, working with Dr. Carl Griffin, member of the Associate Faculty of the training grant, arranged site visits to Frito Lay, Lake Erie Screw, and McGill companies, to provide student ergonomic reports. These reports contain recommendations to decrease musculoskeletal disorders among the workers.

Dr. Zimmerman continued to work with Purdue's Technical Assistance Program, providing consultation to a local business on potential ventilation problems and worker chemical overexposure. A second local project involved evaluation of vinyl hospital products toxicity.

Dr. Zheng has worked with Dr. Gary Carlson to help Indiana Department of Environmental Management (via Mr. Mitt Denney, a Senior Manager in Ground Water Section) to assess the risk associated with drinking water contamination in a local water supply facility.

The following technical assistance projects were completed by Dr. McGlothlin:

Purdue's Technical Assistance Projects conducted by James McGlothlin, from the School of Health Sciences for Engagement and Service Activities for companies in the State of Indiana.				
Eaton	South Bend	Custom forgings: gears & shafts for truck, industrial & other vehicle components.	Ergonomic analyses and recommendations for hourly employees.	8/10/2001
FBi Buildings, Inc.	Remington	Commercial construction company.	Evaluation of ergonomic issues in both office and factory operations.	7/23/2002

Delco Remy International	Anderson	Starting motors, generators, high energy ignition systems, horns, switches, controls & batteries, permanent magnets.	Address arm and shoulder ergonomic issues, and methods of monitoring ergonomic problems.	9/17/2002
Wabash MPI	Wabash	Manufactures hydraulic, laboratory, laminating & molding presses	Review of potential ergonomic issues.	11/12/2002
Dexter Axle	North Manchester	RV axle components, electric brakes, hubs and drums.	Improvement of worker ergonomics.	3/19/2003
Bottcher America Corp.	Tipton	Re-cover printing press rollers.	Evaluation of worker safety issues.	7/31/2003
ITW Ramset/Red Head	Michigan City	Manufactures concrete anchoring systems.	Reduction of repetitive stress injuries.	6/20/2003
FBi Buildings, Inc.	Remington	Commercial construction company.	Improvement of worksite ergonomics.	9/9/2004
Cook Biotech	West Lafayette	Commercial Economic, Sociological & Educational Research.	Development of a comprehensive production safety plan.	4/27/2005
Ryder Integrated Logistics	Plainfield	Logistics and transportation.	Ergonomics review.	5/10/2005
Dynamic Corporation	Montmorenci	Electrical resistors	Noise level reduction.	11/28/2005
MCC Inc.	Indianapolis	Consultant	Interpretation of OSHA regulations regarding power cranes.	1/10/2006
Kirby Risk Precision Machining	Lafayette	Machine shop: CNC, general & specialty machining, blanchard & surface grinding, flame cutting, drilling, lathe & mill work.	Analysis of a potentially dangerous substance in a manufacturing plant.	5/1/2006
Laibe Corporation	Indianapolis	Manufactures water well drilling rigs & supplies.	Provide method for measuring the force required to depress a clutch on a truck chassis.	8/1/2006

Student Awards and Achievements

Purdue graduate students in Occupational Health Sciences won numerous awards in the last grant period. A partial list follows:

- Jason Roggenbauer (Advisor Dr. McGlothlin) won the Best Poster Award at the Chicago

section of the American Industrial Hygiene Association (2001)

- Erica Peterson (Advisor Dr. McGlothlin) won the Tichauer award for best platform presentation in Ergonomics at the American industrial Hygiene Conf and Exposition (2001)

- Mark Powley (Advisor Dr. Carlson) won the following awards in 2001: 1) Second place Best Poster Award, Chicago Section of the American Industrial Hygiene Association, 2) Regulatory and Safety Assessment Poster Award at the Annual Meeting of the Society of Toxicology, 3) Wayne Kessler Graduate Student Award from the School of Health Sciences..

- Rob Eninger (Advisor Dr. Rosenthal) was awarded funding from the University of Cincinnati Pilot Research Program for his research "Occupational Exposure to Particulate Matter and Heart Rate Variability (2001)

- Edward Gazdik (Advisor Dr. Rosenthal) was awarded a grant from the University of Cincinnati Pilot Research Program for his research on the ultraviolet attenuation of laboratory gloves (2002)

- Andrea Essig (Advisor Dr. McGlothlin) won the Tichauer award for best platform presentation in Ergonomics at the American Industrial Hygiene Conference and Exposition (May, 2002).

- Rob Eninger (Advisor Dr. Rosenthal) won the second place award for his research poster presentation at the Chicago section of the American Industrial Hygiene Association (March, 2002)

- Fan Xu (Advisor Dr. McGlothlin) won best poster in the graduate division at the AIHA Chicago Section meeting in March 2003 for her research titled: Video Exposure Assessment of Solvents in Pharmaceutical Laboratories.

- Chie Inumaru (Adviser Dr. Zimmerman') won a "Best in Session" ribbon for her poster presentation on her research, presented at the 2003 AIHce in Dallas, May, 2003.

- Lisa Wagoner and Fan Xu were awarded Industrial Hygiene scholarships provided by the Chicago local section of the American Industrial Hygiene Association. (2003)

- Hubert Lu (Advisor Dr. Zimmerman was awarded a grant from the University of Cincinnati Pilot Research Program for his research involving VOC Adsorption on Activated Charcoal Fibers (2003)

- Hernando Perez (Advisor Dr. Zimmerman was awarded a grant from the University of Cincinnati Pilot Research Program for his research involving the use of HVAC filters as historical records of airborne fungal concentrations.(2003)

- Lisa Wagoner (Advisor Dr. McGlothlin) and undergraduates Matt Raef and Carolyn Neuhoff won best poster in the undergraduate division at the AIHA Chicago local section poster competition (March 2003, for their research entitled: "Ergonomic solutions for A Purdue Student with Special Needs"

- Lisa Wagoner (Advisor Dr. McGlothlin, 2003) and Hubert Lu (Advisor Dr. Zimmerman, 2004) were awarded $5000 national scholarships from the 3M Company.

- Hubert Lu (Advisor Dr. Zimmerman) was awarded an American Industrial Hygiene Foundation $4000 scholarship (2004)

- Mark Knezovich (Advisor Dr. McGlothlin) took first place for best graduate poster at the AIHA Chicago Section Meeting (March, 2004) for his research entitled: "Ergonomic Evaluation and Successful Interventions at an Axle Manufacturing facility in Indiana"

- Lisa Wagoner (Advisor; Dr. McGlothlin) took second place for best graduate poster at the AIHA Chicago Section Meeting (March, 2004) for her research entitled: "Evaluation of Noise Attenuation and Verbal Communication Capabilities Using Three Ear Insert Hearing Protection Systems among Airport Maintenance Personnel".

- Lisa Wagoner (Advisor; Dr. McGlothlin) won the award for the best poster presentation on Noise at the AIHce (May 2004)

- Fan Xu (Advisor Dr. McGlothlin) was awarded a grant from the University of Cincinnati, NIOSH pilot research program for her research entitled: Postural stability and Fatigue among Residential Roofers. (2004)

- Brent Yeagy (Advisor Dr. Rosenthal) was awarded a grant from the University of Illinois/NIOSH pilot research program for his research entitled: Effect of Autonomic Exposure to Welding Particulates on Autonomic Heart Regulation. (2004)

- Brent Yeagy (Advisor Dr. Rosenthal) was awarded a grant from the University of Cincinnati /NIOSH pilot research program for his research entitled Peak Particulate Exposure and Heart Rate Variability. (2004)

- Lisa Wagoner (Advisor Dr. McGlothlin) won the Wayne V. Kessler graduate student award in the Purdue University School of Health Sciences (April 2004)

- Fan Xu (Advisor Dr. McGlothlin) won a $3000 scholarship from Eli Lilly & Co. for excellence in her graduate studies (April 2005)

- Mark Knezovich (Advisor Dr. McGlothlin) won the Eli Lilly Industrial Hygiene Scholarship in the Purdue University School of Health Sciences (April 2004)

- Tom Bonner (Adviser: Dr. Zimmerman) won first place in the Graduate student poster competition at the Chicago local AIHA Section for his research on exposure to diesel exhaust in school buses.

- April Rademaker (Advisor, Dr. McGlothlin) won the 3000 scholarship from Eli Lily and Co. for excellence in her graduate studies (April 2006)

- Alina Goh (Advisor, Dr. McGlothlin) won the best poster for Ergonomics Research at the American Industrial Hygiene Conference and Exposition in Chicago, IL (May 2006).

Faculty Awards and Achievements

Dr McGlothlin was appointed Purdue Faculty Scholar (2004), and a Regenstrief Center for Healthcare Engineering Scholar (2006). Dr. McGlothlin received the Focus Award for outstanding contributions to disability accessibility and diversity (2004). Dr. Rosenthal received the School of Health Sciences Award for Excellence in Teaching (2004). Dr. Zimmerman was elected to the Board of Directors of the American Industrial Hygiene Association. Dr. McGlothlin became a fellow of the American Industrial Hygiene Association. Dr Zheng was promoted to full professor. Both Drs Zheng and McGlothlin received the "seeds of success" award from the Provost for bringing significant grant projects exceeding 1 million dollars to Purdue in 2006.

ABET Accreditation

The program received full re-accreditation in 2004. Both the graduate and undergraduate programs in industrial hygiene were re-accredited.

Regional outreach

Drs. Rosenthal and Zimmerman continue to serve on the steering committee of the University of Cincinnati/NIOSH pilot research program. Purdue participates with several other universities in the Chicago AIHA section student research poster competition every year. Faculty from the Indiana University School of Medicine and the University of Illinois School of Public Health, serve on the Associate faculty of this program. Dr. McGlothlin is an adjunct Professor at the School of Public Health at the University of Iowa.

Participation in University Interdisciplinary Programs in Public Health and Environmental Science

The School of Health Sciences and in particular faculty members Drs. Rosenthal and McGlothlin have been involved in an initiative to establish a Masters of Public Health program at Purdue. The initiative led by the Department of Health and Kinesiology is focused on community health education. It is anticipated that participation in this program will open up more opportunities for collaborative teaching as well as recruitment of students into further graduate study at the doctoral level in occupational and environmental health.

The faculty of the School of Health Sciences, and in particular Drs. Carlson and Rosenthal, have participated in establishing of a new Purdue center for environmental research. The center has been established with $5 million in start-up funds and is focused on facilitating innovative environmental planning and "green" technological development. Concurrently, a group of over 200 Purdue faculty is launching a Purdue Institute for the Environment which will foster interdisciplinary collaboration in teaching and academic programs. Drs. Carlson and Rosenthal have participated in these initiatives, providing input on the human health aspects of environmental exposures in both occupational and community settings.

Dr. McGlothlin is the acting Technical Director for the Regenstrief Center for Healthcare Engineering at Purdue University. He serves on the operations and executive committees and has active Center projects that use engineering controls to protect patients and healthcare personnel.

PUBLICATIONS RESULTING FROM THIS GRANT (NIOSH trainees are in bold)

Papers in Peer-reviewed Journals (trainee authors in bold)

1. **Powley, M.W.** and Carlson, G.P. Cytochrome P450 isozymes involved in the metabolism of phenol, a benzene metabolite. Toxicol. Lett. 125: 117-123, 2001.

2. **Powley, M.W.** and Carlson, G.P. Hepatic and pulmonary microsomal benzene metabolism in CYP2E1 knockout mice. Toxicology 169: 187-194, 2001.

3. **Powley, M.W.** and Carlson, G.P. Benzene metabolism by the isolated perfused lung. Inhalation Toxicology 14: 569-584, 2002.

4. **Gazdik, E,** Rosenthal F.S. Attenuation of Laboratory Gloves to Ultraviolet Radiation from a Transilluminator. J. Occup Env Hygiene 1: 291-302 (2004).

5. **Sheets, P.L.** and Carlson, G.P. Kinetic factors involved in the metabolism of benzene in mouse lung and liver. J. Toxicol. Environ. Health 67: 421-430, 2004.

6. **Sheets, P.L.**, Yost, G.S., and Carlson, G.P. Benzene metabolism in human lung cell lines BEAS-2B and A459 and cells overexpressing CYP2F1. J. Biochem. Mol. Toxicol. 18: 92-99, 2004.

7. **Wagoner, L.**, McGlothlin, JD, Chung, K, Strickland, B, and Zimmerman, N. Evaluation of noise attenuation and verbal communication capabilities using three ear insert hearing protection systems among airport maintenance personnel. J Occup Env Hygiene (in press, January 2007).

8. **Perez HR**, NJ Zimmerman, Z Berhane Evaluation of culturable particle load on HVAC filters before and after remediation: a pilot study. Indoor and Built Environment (In Press, 2006)

Abstracts and Presentations

1. **Gazdik, E,** Rosenthal F.S. Attenuation of Laboratory Gloves to Ultraviolet Radiation from a Transilluminator. American Industrial Hygiene Conference and Exposition, Dallas, 2003

2. **Perez, H.R.** and N.J. Zimmerman, Quantification of Fungi on Heating Ventilation and Air Conditioning System Filters. (poster) Presented at the AIHA Chicago Local Section Student Night, February 2003, Chicago, Illinois.

3. **Perez, H.R.** and N.J. Zimmerman, Evaluation of a Method to Quantify Fungi on Heating, Ventilating and Air-Conditioning Filters. (poster) Presented at the American Industrial Hygiene Conference and Exposition, June 2003, Dallas, Texas.

4. **Perez, H.R.** and N.J. Zimmerman, Validation of a Method to Qualify Fungi on Heating Ventilation and Air Conditioning System Filters. Presented at the University of Cincinnati Pilot Research Project Symposium, October 2003, Cincinnati, Ohio.

5. **Perez, H.R.** and N.J. Zimmerman, Viable Fungal Concentration on HVAC Filters as a Predictor of Average Airborne Fungal Concentrations. (poster) Presented at the University of Cincinnati Pilot Research Project Symposium, October 2003, Cincinnati, Ohio.

6. **Perez, H.R.** and N.J. Zimmerman, Extraction and Quantification of Viable Fungal Particles from HVAC Filters as Indicators of Relative Airborne Levels in Building Air. Presented at the American Industrial Hygiene Conference and Exposition, May 2004, Atlanta, Georgia.

7. Perez, H.R. and N.J. Zimmerman, Detection of Indoor Airborne Fungal Contamination through Examination of HVAC Filters,. Accepted for presentation at Indoor air 2005: The 10th International Conference on Indoor Air Quality and Climate, September 2005, Beijing, China. (Manuscript accepted for conference proceedings)

8. Zimmerman, NJ, **Perez, V.** The Effectiveness of Antifungal Agents as Inhibitors of Mold Growth on Gypsum Wallboard, AIHce, Anaheim (May, 2005)

9. **Wagoner, LL**, Raef, M, Hagen, Neuhoff C, Kempf, S, McGlothlin, JD. Ergonomic Interventions for a university student with special needs. Poster at AIHce, Dallas, TX (May, 2003)

11. **Powley, M.W.** and Carlson, G.P. Examination of benzene metabolism: the significance of the lung and the cytochrome P450 isozymes involved. Presented at the 2001 Chicago Section of the American Industrial Hygiene Association Student Night.

12. **Powley, M.** and Carlson, G. Benzene metabolism by the isolated perfused rodent lung following systemic exposure. Toxicologist 60: 96, 2001. Presented at Society of Toxicology Annual Meeting.

13. **Sheets, P.L.** and Carlson, G.P. The kinetic factors involved in the metabolism of benzene in the mouse lung and the evaluation of benzene metabolizing ability within the human lung cell line BEAS-2B. American Industrial Hygiene Conference and Exposition, May, 2003.

14. **Perez HR**, NJ Zimmerman, H Cember, F Rosenthal (2005) Detection of indoor airborne fungal contamination through examination of HVAC filters. In Yang X, B Zhao, R Zhao (eds) Proceedings of the 10th International Conference on Indoor Air Quality and Climate, September 2005, Beijing, China: pp.1409-1413