

GRANT TITLE: OCCUPATIONAL MEDICINE ACTIVITIES AND SKILLS: AN EMPIRICAL STUDY

GRANT NUMBER: R01OH008647

PRINCIPAL INVESTIGATOR: Philip Harber M.D., MPH  
Prof., Community, Environment, and Policy Division  
Mel and Enid Zuckerman College of Public Health  
University of Arizona

ADDRESS: Medical Research Building- Room 112  
University of Arizona- MEZCOPH  
1656 E. Mabel St.  
Tucson, AZ 85719

PROJECT DATES: 09/01/2007 – 08/31/2012

COINVESTIGATORS: Anton Westveld PhD  
David Elashoff PhD

DATE December 8, 2012  
(Updated) August 21, 2013

INSTITUTION University of Arizona

OTHER INSTITUTION: University Of California, Los Angeles

## TABLE OF CONTENTS

SECTION #1 SIGNIFICANT FINDINGS .....	4
◇ What elements (activities and skills) are in common across the field? Are there distinct subgroups within the field? .....	4
◇ What activities depend on skills unique to OM? To what extent do occupational preventive medicine practitioners actually employ the skills? .....	4
◇ To what extent is the field focused on prevention versus treatment? .....	4
◇ What determines practice activities? .....	4
Secondary aims: .....	5
◇ Delineate skills and activities that are most valued by occupational preventive medicine practitioners.....	5
◇ Develop a methodology useful for assessment of practices, skills, and impact for other occupational health disciplines.....	5
◇ Assess overlap between the subspecialties of Occupational and General Preventive Medicine.....	5
◇ Describe the frequency of nonoccupational environmental activities (both clinical and other) .....	5
◇ Describe the typical career path in the field .....	5
◇ Apply these approaches to industrial hygiene (IH), occupational health nursing (OHN), and other occupational health/public health disciplines .....	5
TRANSLATION OF FINDINGS .....	5
SECTION 2: SCIENTIFIC REPORT .....	7
APPROACHES.....	7
Phases .....	7
Activity Metrics .....	7
Subgroups .....	7
Overall Activities .....	8
Determinants: .....	8
Career Paths.....	8
Distribution of pulmonary and toxicology occupational problems .....	8
Interactions: .....	10
Inclusion Enrollment Report .....	11
PUBLICATIONS & MAJOR PRESENTATIONS.....	12

### LIST OF TERMS AND ABBREVIATIONS

AAOHN	American Association of Occupational Health Nurses
ABIH	American Board of Industrial Hygiene
ABOHN	American Board of Occupational Health Nursing
ACGME	Accreditation Council for Graduate Medical Education
ACOEM	American College of Occupational and Environmental Medicine
CIH	Certified industrial hygienist
IH	Industrial hygienist/ industrial hygiene
OH	Occupational health
OHN	Occupational health nurse/occupational health nursing
OM	Occupational medicine physician/ occupational medicine
OMP	Occupational Medical Practice (Project acronym)
OMP1, 2	Phases 1 and 2 of OMP
MD	Medical doctor, generally refers to occupational medicine physicians herein
NP	Nurse practitioner
PA	Physician assistant

## ABSTRACT

### "Occupational Medicine Activities and Skills: an Empirical Study"

Principal investigator: Philip Harber, M.D., MPH

Contact: e-mail: [pharber@email.arizona.edu](mailto:pharber@email.arizona.edu)

Telephone: 01 – 520-626-1263

This research quantitatively describes activities and skills of three occupational health professional disciplines. This may inform educational curricula, professional certification criteria, organization of services, and training program impact assessment. This research was based on empirical data rather than opinions of experts or general surveys of practitioners.

The researchers recruited a national sample of 412 occupational physicians, 129 occupational health nurses, and 196 industrial hygienists, all of whom answered baseline descriptive questions and submitted logs describing activities at specific times. These professionals generated a total of approximately 11,600 individual activity logs. Analyses show:

(1) Despite three distinct practice patterns – "injury care", "subspecialty care", and "population/management medicine" – occupational medicine has common elements which distinguish services from those of other physicians. Musculoskeletal problems are most common, but there is a significant component of pulmonary and toxicologic problems.

(2) Board-certified occupational physicians provide a greater variety of services, use more skills, and are more public health-oriented than those who are not certified.

(3) Occupational health nurses and industrial hygienists are predominantly employees of large entities and are more directly associated with specific worksites than physicians, who are more frequently in smaller clinical (i.e. non-worksites) offices and compensated by fee-for-service workers' compensation payments.

(4) Management and communication activities are common for all three disciplines. Nurses perform as much direct "hands-on" care as indirect patient care. Industrial hygienists perform more evaluation than control activity.

(5) Activity patterns vary with career stage, and significant career transitions are frequent. The proportion of physician first jobs in a corporate or other nonclinical setting is lower than in the past, but transitions from clinical to nonclinical roles occur over time.

(6) Interactions are predominantly within discipline rather than between professional disciplines.

(7) The work of occupational physicians and nurses is very focused in occupational health rather than environmental health. Industrial hygienists are similarly focused.

Implications: (a) There are significant incongruities between actual practice skills and many educational curricula. (b) Formal training and board certification in occupational medicine has significant beneficial impact in terms of diversity of skills and incorporating population-based approaches. (c) Managerial as well as technical skills are necessary and should be addressed in training/certification. (d) The study underscored the need for improving interdisciplinary practice interactions. (e) The online point in time methodology developed for this study may be applicable to other analyses of services' structure and function. (f) Worker health and productivity may be enhanced by carefully targeting the education and skills of occupational health professionals. Professional certification for occupational physicians, occupational health nurses, and industrial hygienists may be informed by empirical understanding of their actual work activities.

## SECTION #1 SIGNIFICANT FINDINGS

The project aimed to determine the specific skills and competencies necessary for occupational health using a combination of activity logs completed by occupational health professionals, advisory/focus groups, and more general questionnaires. This section briefly summarizes key findings according to the project's aims. The project initially studied occupational medicine physicians (OM), but then expanded to include occupational health nurses (OHN) and industrial hygienists (IH). The project's aims were addressed:

◇ What elements (activities and skills) are in common across the field? Are there distinct subgroups within the field?

Both baseline questionnaire and activity log data support the presence of three distinct OM practice groups. "Injury Care" physicians provide front-line direct patient care for occupational injuries, particularly involving the spine and other musculoskeletal areas. In addition, they conduct many routine surveillance examinations. Their work is predominantly supported by workers' compensation payments. "Clinical (sub) specialists" are analogous to internal medicine subspecialists. While they also treat musculoskeletal conditions, other problems – toxicologic, pulmonary, and dermatologic – occur more often than for the injury care physicians. In addition, while workers' compensation payment remains important, other sources also contributed a significant amount. The number of patients seen per week by "Injury Care" physicians exceeds that of "clinical subspecialists". The third group, "Population Medicine/Management", is much less clinically-oriented and spends proportionately more time in management or public health activities. Although three practice pattern groups were identified, the study also showed significant commonalities among the three groups.

◇ What activities depend on skills unique to OM? To what extent do occupational preventive medicine practitioners actually employ the skills?

Many of the activities, particularly oriented to clinical treatment, are similar to services of other physician providers. However, several aspects are likely specific to occupational physicians. For example, the clinical practices of occupational physicians uniquely emphasize work ability/disability, work activity restrictions and accommodations, and work status. Many practices also include managerial and population-based aspects.

◇ To what extent is the field focused on prevention versus treatment?

This empirical study demonstrated that treatment (a.k.a. tertiary prevention) accounted for considerably more practice time than did primary prevention. Nevertheless, both primary and secondary prevention activities were incorporated in the activities of many occupational physicians.

◇ What determines practice activities?

Practice setting influenced activities and skills (e.g., corporate and university practitioners differed from others). Notably, in comparison to non-board-certified physicians, OM board-certified physicians performed a greater variety of services/skills (as opposed to providing completely different services). (E.g., certified physicians provided both musculoskeletal care and nonclinical and toxicologic work). Multivariable analyses showed that the certification effect was not due to confounding by career stage. Board certification was associated with proportionally less workers' compensation reimbursement, more time with toxicologic problems (6% versus 1%), and greater focus on the workplace environment per se (4% versus 2%).

The study also examined career paths by a standardized retrospective questionnaire for a separate physician sample. Since the main study was cross-sectional, this questionnaire helped determine whether the field had fundamentally changed or if the career stage simply represented normal career progression in an otherwise unchanging field. This sub-study showed that major career transitions were frequent (40% of participants), and that transition from clinical to nonclinical work was more common than the converse.

### **Secondary aims:**

#### ◇ Delineate skills and activities that are most valued by occupational preventive medicine practitioners

From baseline questionnaires and focus groups, the study determined the self-stated priorities for clinicians and other practitioners. (Also, courses most and least valued by OHN and IH differed),

#### ◇ Develop a methodology useful for assessment of practices, skills, and impact for other occupational health disciplines

The method of work sampling by multiple activity description logs at specified times (described by one participant as a “Twitter”) as well as the summarization approaches apply to other disciplines.

#### ◇ Assess overlap between the subspecialties of Occupational and General Preventive Medicine

As a secondary aim, there were too few physicians with board certification only in general preventive medicine to meaningfully compare to the occupational medicine certified physicians.

#### ◇ Describe the frequency of nonoccupational environmental activities (both clinical and other)

Occupational physicians and nurses are very focused in occupational health; actual practice activities include very limited environmental (non-workplace related) health work for most practitioners. However, a systematic survey of occupational medicine residency websites found an emphasis on environmental health that is disproportionate to the actual activities and practitioners.

#### ◇ Describe the typical career path in the field

Career stage (early, mid, senior, or late career) also significantly affected OM practice activities. In early career stages, physicians spend proportionately more time directly treating injured/ill patients, depend proportionately more on workers’ compensation reimbursement, and work more often in clinical settings. IH and OHN were recruited with significant assistance from the cognate certifying boards (AAOHN, ABIH) and therefore the data reflect activities and skills of experienced professionals.

#### ◇ Apply these approaches to industrial hygiene (IH), occupational health nursing (OHN), and other occupational health/public health disciplines

In contrast to occupational physicians, IH and OHN professionals are generally employed directly by organizational entities and are much more closely related to specific worksites. For both disciplines, management and communication skills are as important as traditional technical skills (e.g., air sampling, direct patient care). For IH’s, “evaluation” work was much more frequent than “control”. OHN’s provided as much “indirect” patient care as direct patient care.

### **TRANSLATION OF FINDINGS**

Potential Outcomes: The results have broad potential implications. The results show a discrepancy between the emphasis of many educational curricula and the actual practice

activities and skills utilized. This illustrates a need to modify curricula and certification processes to reflect actual work needs. Further, the limited proportion of effort devoted to prevention indicates a need to revise reimbursement schemes to incentivize prevention in addition to treatment.

Intermediate Outcomes: Presentations, small group discussions, and publications have facilitated in-depth consideration of fundamental organizational and educational issues. The work has helped shift planning from opinion to data-driven approaches. The ACOEM Competencies revision, which is an ACGME required guide to OM residency training, incorporates the three practice category approach from this study. The demonstration that formal training beneficially impacts practice activities provides empirical data in support of appropriate resource allocation.

End Outcomes: It is premature to assess the ultimate effect of improving the education, certification, and organizational effects of this work.

## SECTION 2: SCIENTIFIC REPORT

### APPROACHES

#### Phases

Studies included two phases: OMP1 developed the methodology and studied occupational physicians over several years. During the final year (OMP2 phase), the original study aims were expanded to include limited study of industrial hygienists and occupational health nurses. (During the course of the study, the PI moved from UCLA to University of Arizona.) Experience from OMP1 and improvement in the capabilities of the Web questionnaire /log software permitted more sophisticated online techniques in OMP2.

This section illustrates several findings, with emphasis on OMP1 (OM). Publications from OMP2 has just finished. The study created a unique empirical database with data from 412 physicians, 129 occupational health nurses, and 196 industrial hygienists, all of whom answered baseline descriptive questions and submitted logs describing activities at specific times. These professionals generated a total of approximately 11,600 individual activity logs.

#### Activity Metrics

Three metrics were designed to summarize individual activities or skills:

(a) *Overall*: Each transaction log is considered an independent record. This is useful for describing overall distribution of activities within a discipline.

(b) *% Time*: The unit of analysis is the individual person; it is calculated as the percentage of his/her logs in which item is present. This facilitates describing variability among subjects in the same profession. It is most useful for delineating subgroups within a profession, evaluating factors determining activities, and assessing the impact of formal training.

(c) *Ever*: Here, each subject is dichotomously classified by whether he/she did a particular activity at least once among logs submitted. This is particularly useful for defining significantly needed skills. (i.e., universal training/verification of a skill is more significant if a high proportion of OH professionals have used it at least once among 15- 25 logs. The same overall% might occur because 4% of physicians used it constantly or if each OM used it at least once. Mandatory training is more important in the former situation). This also supports hypothesis testing of determinants of activities.

Two analogous summary measures were used to describe diversity of practice across many skills: (a) *Individual diversity*, calculated as the number of activity types within a domain (or in aggregate) for an individual, helps assess the effects of training, work setting, etc. (b) *Diversity-significant* is the number of different activities used by at least 25% of members of any group.

### OCCUPATIONAL MEDICINE PHYSICIANS (OMP1)

Several reports have been published, and others are under review or in preparation.

#### Subgroups

The introductory questionnaires supported an *a priori* hypothesis that there are discernible subgroups. These were characterized as: (a) Injury Care – “front-line clinicians” in high-volume clinical practices, emphasizing musculoskeletal disorders, generally supported by workers’ compensation payments. (b) Clinical Specialist – clinicians analogous to internal

medicine subspecialties, with lower volume and greater emphasis on toxicology and pulmonary disorders; (c) Management/Population – physicians whose emphasis is care of populations rather than individuals, often in corporate or public health settings.

### Overall Activities

OM is very focused and clinical in nature. Environmental health, in contrast, constitutes only a small component of activities. Comparable data were seen in IH's. Musculoskeletal problems dominated, but a significant, albeit small, proportion included toxicology. There were significant differences in skills and activities among the three subgroups shown by the logs and the baseline questionnaire data described above. Workers' compensation was by far the major reimbursement source. In contrast to the "overall %" analysis, the "ever" metric demonstrated that a high proportion of physicians in each of the subgroups had some involvement with toxicology. The study also showed that OM physicians often communicated about workplace-relevant aspects that generalists treating the same condition are less likely to consider.

### Determinants:

Both board certification and career stage have significant effects. Board-certified (BC) status is a partial surrogate for residency training. BC physicians' work includes activities done by non-certified physicians, in addition to many others. Diversity of skills and tasks was significantly higher in the BC's. More senior OM's did less frontline care and more managerial work. Joint analysis (ANOVA) confirmed that the effect of certification/training was not simply due to confounding by career stage (see appendix).

### Career Paths

The in-depth cross-sectional description of OM cannot distinguish if the career stage effects are due to age/experience or indicate a secular change in the nature of OM. Therefore, a smaller ancillary study used a highly standardized retrospective assessment of physicians' work at various career stages. Previously, OM combined clinical and non-clinical activities. Opportunities for a "first job" in a non-clinical setting are less frequent now. Career transitions are frequent, more often in the clinical to non-clinical direction than the reverse.

The following reports are under review or in preparation:

#### Distribution of pulmonary and toxicology occupational problems

These "specialized" areas, while relatively infrequent, were relevant to the activities of a high proportion of all physicians (e.g., 38% had at least one pulmonary case), suggesting that, overall, nearly all OM's at some point should have some competency in these areas (published as an abstract for the American Thoracic Society).

### Synthesis

This will be a policy-oriented paper based on the empirical data for all three disciplines.

### **OCCUPATIONAL HEALTH NURSES, INDUSTRIAL HYGIENISTS (OMP2)**

OMP2 is a shorter, smaller study added in the last year; final analysis and report preparations are in progress.

The IH and OHN sample was nationally representative, but it included a high proportion of senior and certified professionals due to the truncated recruitment time and unusually active recruiting assistance of both of the certifying boards (ABIH, ABOHN); 94% and 91% were CIH and COHN, and the mean ages were 49 and 54 years respectively. All data are described for IH and OHN respectively unless otherwise specified.

Analyses assess how strongly activities and skills are influenced by education and certification for both IH and OHN. Educational attainment varied considerably among nurses (e.g., 19% had an associate degree or RN only, 36% had at least a master's degree), with only a moderate correlation between educational attainment and certification status.

There were many similarities between the IH's and OHN's. They are largely employed by companies (36% and 45%) rather than being self-employed (2% and 1%), working for consulting companies (14% and 2%), or working directly in healthcare delivery institutions (5% and 36%). Although 15% of the nurses' logs were related to employment in a medical center, activity patterns suggest they were serving the needs of medical center employees rather than external patients. In contrast, most physicians were in clinical settings with about 23% directly employed by large employers. "Workers' compensation" largely paid for physician services, whereas employer-based direct payment primarily supported IH's and OHN's (78% and 79%, respectively).

Management activities were very important for all groups (23%, 21% of IH and OHN logs; average of 10% of physician time). Management activities served largely internal purposes rather than assisting other employers. "Administrator" job titles (such as "manager", "administrator", "director") were common (34%, 50%). Even in the "early career stage" physicians, managerial and communication work was quite frequent. These data suggest that educational curricula and certification processes should incorporate management and communication in addition to technical aspects, particularly if training is for a lifelong career rather than the first job. Direct patient care accounted for 23% of the nurse logs, but indirect patient care was nearly as significant (16%). Hygienists measured exposures considerably more frequently than they controlled exposures (e.g., 21% versus 10%). The table below summarizes most frequent logged tasks (high to lower, among 110 choices).

<p><u>OHN:</u> Case Management, Coordinating Care, Planning Programs (Occupational Health), Workers/Employees of My Company, Follow-up Visit, Screening Exam (OSHA-Required), Pre-Placement Examination, Other Regulatory Compliance Review, Screening Exam (Other), Recordkeeping, First Visit (Injury), Occupational Health Procedure Documentation, Occupational Health Staff Training, Physical Examination, Other Worker Training, Spirometry Audiometry or Vision, OSHA Compliance Review, First Aid. <u>IH:</u> Technical Report, Air Sampling, Workers/Employees of My Company, Other Regulatory Compliance Review, OSHA Compliance Review, OSHA-Required Worker Training, Indoor Air Quality, Noise, Safety Audit, Hazard Assessment, Other Worker Training, Audit Program, Citations, Planning Programs (Occupational Health), Internal Audit, Occupational Health Staff Training, Risk Communication, Occupational Health Procedure Documentation, Office Ergonomics. (Comparable data are available for "tools used", "activity goal", and other variables)</p>
---

The relative frequency of categories of problems addressed was assessed by questions about "organ system" and "hazard" involved in each log, whether clinical or not. These frequencies differed among the three professional disciplines. For hygienists, pulmonary and toxicology accounted for 16% and 6% of activities, whereas these totaled only 7% for the nurses. For the physicians, pulmonary and toxicology accounted for 3%, 4% of reported times respectively. Chemical hazards were often involved for the hygienists (24%

"chemical", 3% carcinogen), contrasting with the nurses for whom these totaled only 3%. "Safety" hazards were important for both nurses and hygienists (16%, 15%).

Interactions:

Although study of disciplinary interaction patterns was not a primary aim of the project, relevant data prompted the investigators to propose the follow-up study to more closely analyze this area. In both OMP1 and OMP2, the "with whom" questions reflected interaction patterns by asking for the roles of any other individuals currently interacting with the participant. The tables below synthesize results for OM, OHN, and IH. The results show that interactions are limited among the disciplines. Most are within type (e.g., clinical professionals with clinical professionals only, IH mainly with IH or safety professional).

The question format between OMP1 and OMP2. Those marked with\* in these tables were calculated to be as reasonably matched as possible. NA = not fully analogous. In OMP2, IH and safety often overlapped. In addition, clinical management interactions and nonclinical management were collected in more detail and cannot be simply combined in this table.

Interaction Patterns

	Overall % of Logs with Interaction			"Ever" (% of professionals with >= 1 interaction)		
	MD	IH	OHN	MD	IH	OHN
Med Assistant	25%	0%	2%	39%	3%	15%
Nurse	17%	1%	9%	47%	12%	42%
MD/DO	7%	1%	4%	39%	9%	28%
Manager – Clinical*	NA	1%	3%	NA	9%	22%
PA/NP	3%	0%	2%	18%	2%	12%
Manager – Non-Clinical*	NA	10%	8%	NA	60%	53%
IH	2%	22%	5%	20%	48%	7%
Lawyer	1%	1%	1%	10%	6%	11%
Safety Professional*	NA	NA	NA	(in IH)	60%	39%

**Study Title:** Occupational Medicine Activities and Skills: An Empiric Study  
**Total Enrollment:** 737 **Protocol Number:** \_\_\_\_\_  
**Grant Number:** R01OH008647

<b>PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race</b>				
<b>Ethnic Category</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
Hispanic or Latino	1	4	5	10 **
Not Hispanic or Latino	195	139	1	335
Unknown (individuals not reporting ethnicity)	1	1	390	392
<b>Ethnic Category: Total of All Subjects*</b>	197	144	396	737 *
<b>Racial Categories</b>				
American Indian/Alaska Native	0	0	1	1
Asian	7	3	43	53
Native Hawaiian or Other Pacific Islander	0	1	0	1
Black or African American	5	2	6	13
White	171	124	207	502
More Than One Race	0	0	0	0
Unknown or Not Reported	1	3	163	10
<b>Racial Categories: Total of All Subjects*</b>	184	133	420	737 *

<b>PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)</b>				
<b>Racial Categories</b>	<b>Females</b>	<b>Males</b>	<b>Sex/Gender Unknown or Not Reported</b>	<b>Total</b>
American Indian or Alaska Native	0	0	0	0
Asian	0	0	0	0
Native Hawaiian or Other Pacific Islander	0	0	0	0
Black or African American	0	0	0	0
White	0	2	5	7
More Than One Race	0	0	0	0
Unknown or Not Reported	1	2	0	3
<b>Racial Categories: Total of Hispanics or Latinos**</b>	1	4	5	10 **

\* These totals must agree.

\*\* These totals must agree.

## **PUBLICATIONS & MAJOR PRESENTATIONS**

### Published/printed:

Harber P, Bontemps J, Saechao K, Wu S, Liu Y, Elashoff D. Career paths in occupational medicine. J Occup Environ Med. 2012; 54(11):1324-9

Harber P, Rose S, Bontemps J, Saechao K, Liu Y, Elashoff D, Wu S. Occupational medicine practice: activities and skills of a national sample. J Occup Environ Med. 2010 Dec;52(12):1147-53.

Harber P, Rose S, Bontemps J, Saechao K, Liu Y, Elashoff D, Wu S. Occupational medicine practice: one specialty or three? J Occup Environ Med. 2010 Jul;52(7):672-9.

Harber P, Wu S, Bontemps J, Rose S, Saechao K, Liu Y. Value of occupational medicine board certification. J Occup Environ Med. 2013 May;55(5):532-8.

Wu S, Harber P, Bontemps J. Are Occupational Pulmonary Problems Evaluated By Low Patient Volume Occupational Medicine Subspecialists? Am J Respir Crit Care Med 185;2012:A2305 (abstract)

### Completed Manuscripts pending review:

Harber P, Alongi G, Su J, Barret S Educational Needs and Activities of Experienced Occupational Health Nurses and Industrial Hygienists: Survey Results

Harber P, Alongi G, Su J. Professional Activities of Occupational Health Nurses

Alongi G, Harber P, Su J, Brosseau, L. Practice Activities of Industrial Hygienists: An Empirical Study

### Manuscripts anticipated/ in development:

Comparison of professional practice structure for occupational physicians, nurses.

Activities and skills of occupational health nurses

Professional activities of experienced industrial hygienists

“Environmental” extent of “occupational- environmental medicine” practice

### Presentations

Occupational Health Competencies. Occupational Health Nurses Tri-Association, Long Beach. 2009

Harber P. Environmental Health Management Skills and Competencies. National Association of Environmental Managers. Tucson, October 2011.

Harber P. Occupational Medicine Practice-Empirical Data. American Occupational Health Conference (Washington); 2011

S. Wu, P. Harber J. Bontemps. Are Occupational Pulmonary Problems Evaluated By Low Patient Volume Occupational Medicine Subspecialists? Am Thoracic Society, (San Diego) 2011