Occupational Medicine Physicians in the United States: Demographics and Core Competencies

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Objective: *We assessed the demographic profile and opinions of current occupational medicine (OM) physicians on the importance of specific core competencies.* ***Methods:*** *A random sample of 1500 OM physicians listed in the membership directory of the American College of Occupational and Environmental Medicine (ACOEM) were asked to complete a voluntary survey.* ***Results:*** *Six hundred and ten OM physicians completed the survey. Fifty two percent worked in clinical settings, and 16% worked in corporate or industrial settings. Eighty percent were satisfied with their choice of careers.* ***Conclusions:*** *OM physicians appeared to be highly trained, with 60% certified in OM and 68% board certified in other specialties. The OM physicians valued staying current in the field, understanding the relationship between occupational exposure and health, and communicating with stakeholders most highly. Occupational physicians are an important source of knowledge regarding what competencies and core knowledge areas are important for OM practice.* (J Occup Environ Med. *2007; 49:388–400*)

The Institute of Medicine (IOM) has highlighted the need to maintain quality medical care and to optimize training of physicians in the core competencies or areas of knowledge needed to provide optimum patient care.[1] Occupational medicine (OM) as a field of practice has changed dramatically over the past 20 to 30 years,[1–8] with expansion to encompass environmental medicine in addition to occupational medicine. The practice of OM is continually evolving in response to global and domestic economic issues, technologic changes, health care and social trends, and deindustrialization within the United States.[5–8] OM physicians are increasingly asked to address issues of health promotion and optimize all aspects of the worker's health, not just to focus on work-related injuries.[7]

Despite these changes, workers' health and safety continue to be a major concern worldwide, and it is important that OM physicians have the appropriate skills and competencies to improve the health of the worker. The World Health Organization (WHO) expressed concerns in 2006 that too many workers are still exposed to unacceptable levels of occupational risks, and too few workers have access to occupational health services.[9] The WHO stressed the need for improved occupational health services worldwide and highlighted changes in the working world due to globalization, new technology, and improved communication tools.[9] To address changes in OM

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practice climate, Frumkin suggested that OM physicians reinvent themselves and spend more time addressing health issues in industrializing nations, marginalized workers, postindustrial hazards, and environmental exposures.[6]

Training Needs and Maintaining Competency

How to meet the ongoing training needs for occupational physicians and maintain competency is the subject of an ongoing discussion at the American College of Occupational and Environmental Medicine (ACOEM) and other venues. To support such discussions, information is required on patterns of practice and priorities among current OM physicians. In particular, informed opinion is required to determine what core competencies and areas of core knowledge are emerging as important for OM practice. A survey of European OM physicians was published in 2000,[10] and a survey of UK occupational physicians was published in 2005.[11] There has been no recent comparable recent survey of OM physicians in the United States, however, and market forces and needs may be different in Europe, where employers are often required to provide specific OM services.[10,12]

Current Market Forces in the United States

In an attempt to fill this gap in knowledge in the United States, we conducted a nationwide survey to characterize current OM physician demographics, and to assess job satisfaction as well as the importance of specific core competencies or areas of core knowledge for the proficient practice of OM in the United States. Understanding current market forces in the United States is essential in helping determine the future course of OM training.[12] Certification as an OM specialist in the United States requires a 2-year occupational medicine residency program, consisting of 1 year of didactic instruction based on the Master of Public Health (MPH) degree and a 1-year practicum experience, following at least 1 year of clinical training. Most occupational physicians who seek certification exceed these basic requirements and are often already board certified in other specialties. Many US physicians enter OM practice without qualifying for OM specialty certification, in part because an alternate pathway for OM certification, based largely on experience, has been closed (unless the physician graduated from medical school before 1984).

Practice Climate

The practice climate for OM physicians has changed dramatically in the last 20 to 30 years. The proportion of OM physicians working for corporations has fallen from 80% to 20% within the last 10 to 15 years.[5] In 1988, Brandt-Rauf and Teichman[3] predicted that multispecialty practices and health maintenance organizations would pay a larger role in future occupational health services. Postings for corporate OM physicians decreased from 67% in the late 1960s to 27% in the mid-1980s, while job postings for academic and clinical-based positions increased.[4] Guidotti and Cowell,[13] in 1997, noted similar changes in the practice of OM in Canada, including downsizing of corporate occupational medicine departments and increasing physicians in private OM practice.

In this changing marketplace, OM specialists must deal with a variety of issues, including the social, economic, and administrative needs of workers and employers; integration of OM into community health services; and improving general health of workers.[14,15] OM physicians interact constantly with industry and employers as they focus on the recognition, treatment, and prevention of occupational disease. In addition, OM physicians need to integrate individual clinical treatment and prevention with population-based approaches.[16]

Traditional OM training, which has emphasized public health models and management skills, may need to be modified to include more clinical training. For example, there may be a disconnect between traditional OM residency training, which focuses on prevention, and the clinical skills required of the first jobs for most OM residency graduates.[12] The European survey by MacDonald and coworkers[10] also highlighted the need for better clinical OM training.

Accreditation

Occupational medicine residencies in the United States are accredited through the Residency Review Committee in Preventive Medicine, which is part of the American Council of Graduate Medical Education (ACGME). Within the last 10 years, the ACGME has developed core competencies for clinical training based on traditional clinical training, and has expanded these core competencies to OM.[17,18] Classic medical training focuses on care of individual patients, but this training may be inadequate for addressing population-based health issues such as those encountered in OM.[15] The ACGME core competencies for OM practice combine clinical medicine, administration, public health, environmental health and safety, and other disciplines. The ACGME OM core competencies are similar to, but do not exactly match, the 1998 Competencies of Occupational and Environmental Medicine developed by ACOEM, and the latter are currently being updated.[19]

The relevance of the ACGME core competencies and their applicability to current OM practice need to be assessed. The ACGME highlights the importance of assessing residents' attainment of competency-based objectives in the residency education experience and focuses primarily on patient care.[17] In contrast, the ACOEM competencies include disability management, public health and surveillance hazard management, regulation and compliance management, medicolegal management, relevant social sciences, and aspects of professionalism.[19] The ACOEM and ACGME guidelines ap-

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pear to be complementary, but the validity of each set of core competencies for OM practice has not been well established. Assessing what core competencies or knowledge areas are important to physicians seems particularly crucial for OM practice, which, again, combines clinical medicine with many other disciplines in occupational and environmental health and safety. Due to the multiple skills needed to practice occupational medicine and the changing practice models, the core competencies and knowledge areas needed for proficient OM practice have continued to evolve.

Purpose

This study attempts to identify, via survey, the core competencies or proficiencies that are most important to OM physicians. After completing a European physician survey, MacDonald and colleagues suggested that customer groups such as employers and employees be involved in further refining OM core competencies.[10] Therefore, we also asked OM physicians what core competencies would be important to their organization or employer, because OM physicians are often employed or retained as consultants by industries with specific needs and demands.

Materials and Methods

A random sample of OM physicians listed in the ACOEM membership directory was selected to receive a mailed survey and cover letter, which explained the study. The inclusion criteria for the study included being listed in the 2005–2006 ACOEM directory and having an MD or equivalent degree (DO, MB BS, MB BCh, MB ChB). We randomly selected 1500 names were from the ACOEM directory using the Excel random sampling program (Microsoft Office, Microsoft Corporation, Redmond, Washington). The Minnesota Center for Survey Research at the University of Minnesota sent the study survey and cover letter in an electronic form (if an e-mail address was listed) and mailed version. The University of Minnesota Institutional Review Board and the HealthPartners Institutional Review Board approved the study. The ACOEM Board of Directors endorsed this study and approved the use of its membership directory.

ACOEM is the largest organization of OM physicians in the United States, with approximately 6000 members. The membership directory offered a representative sampling of OM physicians who work in a variety of practice settings. The physicians were offered the choice of completing an on-line version of the survey or a hard-copy version of the survey.

The survey collected information on demographics, board certification, postgraduate training, job satisfaction, the importance of various competencies for proficient practice of OM, and the importance of knowledge areas for the physician's organizations. No personal identifiers such as name, date of birth, or social security numbers were included in the survey items. Subjects who had not returned the surveys were sent two reminder letters to encourage them to complete and return the surveys.

Descriptive statistics were computed for ratings of core competencies, core knowledge areas, and satisfaction ratings. Statistics included measures of centrality (mean) and dispersion (minimum and maximum) for each item separately, and the mean of all items combined. Analyses of variance (ANOVA) and χ^2 statistics were calculated to determine any statistically significant associations between a variety of variables. Significant differences between group means were assessed using the *t* test.

Results

Demographics and Job Satisfaction

A total of 610 OM physicians responded to the survey, yielding a response rate of 40.6%. The majority of the surveys were returned via mail (89.5%). Eighty percent of respondents were male, and the average age was 54.0 years (age range, 33–88 yr) (Table 1). The study respondents were compared with demographic data provided by ACOEM for 4725 physicians who were ACOEM members between October 1, 2005, and September 30, 2006, and who had MD or equivalent degrees. The mean ages and gender distributions were similar between the study group and the overall ACOEM physician membership (Table 1). The proportion with other postgraduate degrees was also similar. For example, 38.4% of the study group had completed an MPH degree, whereas 33.7% of equivalent ACOEM members had completed an MPH (Table 1). Study participants were slightly more likely, however, to be board certified in a variety of areas than the general ACOEM membership was (67.8% vs 64.5%).

Sixty percent of the surveyed OM physicians were board certified in OM, and 63% had taken the OM board examinations. Study participants were more likely to be board certified in OM than all ACOEM physician members (*t* test, $P < 0.001$) (Table 1). The majority of physicians (67.8%) were board certified in specialties other than OM (Table 1). The survey asked physicians if they were board certified in OM and in other areas. Some of the physicians were board certified in multiple specialties. The most common board certifications besides OM were primary care specialties, notably internal medicine (33.9%), family practice (31.6%), emergency medicine (10.1%), and general preventive medicine (9.4%) (Table 1).

Eighteen percent of the physicians had graduated from an OM residency in the last 10 years. Eighty-two percent of the OM physicians had completed other postgraduate training, including residencies or other postgraduate degrees. The most frequent postgraduate degree was an MPH (38.4%). The majority of the study

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TABLE 1
Comparisons of Study Participants With All ACOEM Physician Members Having MD or Equivalent Degrees

	Study Participants (n = 620)	All ACOEM Physician Members (n = 4725)
Mean age (yr)	54.0	54.5
Gender		
Male	80.2%	82.1%
Female	19.8%	17.9%
Completed other postgraduate degrees*	44.7%	40.1%
MPH	38.4%	33.7%
MBA	3.6%	2.1%
JD	0.8%	1.1%
PhD	1.1%	2.1%
Other postgraduate degrees	3.4%	N/A
Board certified in Occupational Medicine (OM)	60.3%	41.5%
Took board examinations in OM	63.4%	N/A
Board certified in at least one other specialty†	67.8%	64.5%
Internal medicine	33.9%	17.9%
Family practice	31.6%	18.8%
Emergency medicine	10.1%	5.8%
General preventive medicine	9.4%	3.8%
Aerospace medicine	6.8%	2.6%
Medical toxicology	2.3%	N/A
Psychiatry	2.0%	1.9%
General surgery	1.5%	N/A
Other	13.2%	13.7%

*Some physicians have multiple postgraduate degrees.
†Some physicians are board certified in one other specialty.
ACOEM indicates American College of Occupational and Environmental Medicine.

participants who were board certified in other specialties had completed residencies in those areas (for example, internal medicine, family practice, and emergency medicine).

Some of the physicians who were board certified in other specialties had not completed a residency program in those specialties and fulfilled alterative criteria allowing them to take the board examinations. This is particularly true for preventive medicine specialties. For example, OM physicians in the past were allowed to take the OM board examination if they met certain educational and practice criteria, without completing an OM residency program. Currently, OM physicians who graduated from medical school before January 1, 1984, are still allowed to take the OM board examination if they fulfill alterative pathway criteria even if they have not completed an OM residency program. The American Board of Preventive Medicine (ABPM) covers three specialities: occupational medicine, general preventive medicine, and aerospace medicine. ABPM allows physicians who are board certified in one of the three covered specialties to take the other board examinations if they fulfill special pathway criteria without completing a full residency in each of these specialities. Similarly, physicians in the past were allowed take board examinations in family practice, emergency medicine, and medical toxicology if they meet alternative pathway criteria, without completing a full residency program.

The most common completed residencies (apart from OM) included internal medicine (33.4%), family practice (29.4%), emergency medicine (6.7%), general preventive medicine or public health (5.9%), aerospace medicine (4.2%), medical toxicology (2.9%), general surgery (2.7%), and physiatry (1.7%). Comparison data were unavailable from ACOEM regarding completed residencies. Other postgraduate degrees included MS, MPHA, PharmD, and MHA. Other completed residencies or fellowships included pediatrics, anesthesia, psychiatry, pulmonary medicine, neurology, sports medicine, infectious disease, obstetrics/gynecology, geriatrics, pathology, nuclear medicine, orthopedics, ophthalmology, and dermatology. Additional non-ACGME-approved certification included Medical Review Officer (23%) and American Board of Independent Medical Examiners (10.1%).

Most of the OM physicians were satisfied with their choice of careers. The physicians were asked, "Knowing what you now know, if you had to choose today to select the specialty of occupational medicine, what would you do?" Thirty-five percent of the physicians would *definitely* select occupational medicine again as a specialty, and 45% would *probably* select occupational medicine again (Table 2), indicating an overall satisfaction with their OM careers expressed by 80% of respondents. Physicians who were board certified in OM were significantly more likely to be satisfied with their career choice (39.8% *definitely* would select OM) than physicians who were not board certified (27.3% would *definitely* select OM) (Table 2). Satisfaction with OM as a specialty did not show a statistically significant correlation with employment setting or size of the organization for which the physician worked.

The OM physicians were also asked about their employment settings. They were asked, "Which one of the following best describes your employment settings?" and were given a list of 15 choices. Most OM physicians worked in clinical set-

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TABLE 2
Satisfaction With Occupational Medicine (OM) Specialty Expressed by OM Physicians

	All Study Participants (%)	Board Certified in OM (%)	Not Board Certified in OM (%)
"Definitely would select" OM again	34.9	39.8	27.3
"Probably would select" OM again	45.4	41.4	51.5
"Probably would not select" OM again	16.1	14.8	18.1
"Definitely would not select" OM again	3.6	3.9	3.1

tings (51.6%), including freestanding OM clinics (25.2%) and multispecialty clinic/hospital settings (18.9%) (Table 3). Sixteen percent worked in corporate or industrial settings such as manufacturing (8.2%), managed care/insurance (3.1%), mining (0.5%), service industries (0.3%), or other corporate settings (4.2%). Only 6.6% worked in academic institutions, and 9.4% worked in government settings. Eleven percent of physicians worked for a consulting company, or they were self-employed. Approximately one-half of the respondents (43.8%) worked for large employers (defined as 2000 or more employees) (Table 3). Approximately one-quarter (21.1%) worked in organizations with less than 50 employees, and 15.5% reported that they were sole proprietors (Table 3).

Twenty-two percent of the OM physicians contracted with outside OM physicians to provide services. Sixty-two percent of the OM physicians worked for organizations that employed other OM physicians. Forty-two percent of the OM physicians worked for an organization with a single site in the United States, and 10.7% worked for international organizations.

Current Issues in the Field of Occupational Medicine

The OM physicians felt that being involved in interesting and challenging work was the most important aspect of their practice (mean response, 4.43 of a possible 5.0) (Table 4). The physicians were asked to rate, "How important to you are the following aspects of OM?" and were given a list of choices. They were asked to rate the importance of these factors from "very important" (score = 5) to "not important" (score = 1) and could also select "not applicable" (score = 0). More than half of the OM physicians felt that being involved in interesting work, promoting worker safety, and treating patients were very important aspects of their practice (Table 4). Doing research (mean response, 2.29) and medicolegal work (mean, 2.82) were less important aspects.

Seventeen percent of the OM physicians felt that the closing of the OM alternative (nonresidency) track or the ability to grandfather into board certification was a major problem in occupational medicine (Table 5). The physicians were asked, "In your opinion, how much of a problem are the following in OM at this time?" Sixteen percent cited meeting employer expectations, and 13% cited funding under the new health care reimbursement model as major problems (Table 5). Fifty-seven percent felt meeting employer expectations was a major or moderate problem in OM. However, the majority of the OM physicians surveyed did not think any of the following issues were moderate or major problems: meeting patient expectations,

TABLE 3
Current Employment and Size of Employer for OM Physicians Surveyed

	Percent
A. Current employment	
Clinical settings	51.6
Freestanding OM clinic	25.2
Multispecialty clinic/hospital	18.9
Other clinical setting	7.5
Consulting	11.5
Consulting firm/self-employed	11.5
Corporate/industry	16.3
Manufacturing	8.2
Other corporate job	4.2
Managed care/insurance	3.1
Mining	0.5
Service	0.3
Government	9.4
Federal/state environmental health and safety	4.6
Federal/state regulatory agency	2.1
Other government job	2.7
Academic setting	6.6
Academic appointment	6.6
Other settings	4.6
University environmental health and safety	1.6
Other	3.0
B. Size of employer	
2000 or more employees	43.8
1000–1999 employees	5.6
500–999 employees	4.1
250–499 employees	3.0
50–249 employees	6.9
<50 employees	21.1
Sole proprietors	15.5

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TABLE 4
Rankings of Perceived Importance of Various Aspects of the Practice of Occupational Medicine (OM)

		Distribution of Scores (Percent)*					
	Mean Score	5	4	3	2	1	0
Being involved in interesting and challenging work	4.43	54.6	33.9	7.4	1.0	0.8	0.2
Promoting worker safety	4.35	53.4	30.0	10.5	2.0	0.3	1.0
Treating patients	4.34	66.7	17.6	8.2	2.3	0.8	4.3
Having control over professional time	4.32	47.9	39.7	10.4	1.3	0.3	0.3
Having a leadership role	4.16	44.6	34.7	15.3	3.6	1.0	0.8
Being involved in a respected profession	4.12	40.7	38.7	15.4	3.2	1.3	0.7
Interaction with colleagues	4.04	31.8	46.1	18.1	2.7	1.0	0.3
Having a comfortable lifestyle	3.92	28.3	43.7	21.6	4.5	1.5	0.3
Diverse job or career opportunities	3.60	27.0	32.2	25.8	7.5	4.2	3.4
Doing medical legal work	2.82	12.1	19.8	29.2	20.1	14.3	4.5
Doing research	2.29	7.9	12.9	24.0	20.5	24.7	9.9

Scores reflect the following responses: 5 = "Very important"; 1 = "Not important"; 0 = "Not applicable."

TABLE 5
Rankings of Current Perceived Problems in Occupational Medicine (OM)

How Much of a Problem are the Following in OM at This Time?	Mean Score	Distribution of Scores (Percent)*				
		4	3	2	1	0
Meeting expectations of employers	2.58	15.4	41.5	26.7	12.1	2
Meeting expectations of patients	2.27	8.4	34.1	34.8	17.7	3.1
Establishing solid base of OM research	2.00	10.8	28	25.6	16.7	16.6
Closing of OM nonresidency track	1.77	17.2	17.4	14.4	22.6	25.6
Funding under new healthcare reimbursement model	1.76	12.6	20.7	20	19.5	25.1
Practicing in a multispecialty model	1.45	3.6	11.3	29	35.2	18.5

Scores reflect the following responses: 4 = "Major problem"; 3 = "Moderate problem"; 2 = "Minor problem"; 1 = "Not a problem"; 0 = "Don't know."

establishing a solid base of OM research, closing OM nonresidency tracks, funding under new reimbursement models, and practicing in a multispecialty setting (Table 5).

General Competencies Important for Proficient OM Practice

OM physicians highly valued core competencies related to hazard recognition and communication. The participants were given a list of the ACGME OM core competencies and were asked, "How valuable do you consider each competency for the proficient practice of occupational medicine?" They were then asked to indicate their rating on a 5-point scale from "not valuable" (score = 1) to "very valuable" (score = 5). More than 50% of the OM physicians ranked the following eight competencies as "very valuable": staying current in one's field of practice (72%), understanding the link between occupational exposure and outcomes (70%), communicating effectively with a variety of stakeholders (70%), identifying and dealing with ethical dilemmas at work and working in an ethical manner (64%), identification of health and safety hazards at work sites (62%), functioning effectively on an interdisciplinary team (59%), communication with other health and safety professionals (59%), displaying effective leadership (58%), and knowing occupational health and safety laws (55%) (Fig. 1). Very few respondents (less than 2%) felt that these eight core competencies were not important. In comparison, less than 25% of OM physicians felt that the following core competencies were valuable for the proficient practice of OM: design and initiate research (4%); design and deliver adult education programs (11%); gather, manage, and analyze data (14%); design and implement health promotion programs (22%); and measure and evaluate program performance (22%) (Fig. 1).

Nine of the core competencies received similar ratings by physicians in a variety of practice settings (no statistically significant differences by ANOVA). However, 14 of the 24 core competencies did show significant differences in ratings by a variety of practice groups (Table 6). We excluded practice settings that had less than 13 participants for this analysis of variance. The largest differences in ratings by practice settings ($P < 0.001$) occurred in core competencies involved in evaluation and collection of data (Table 6). The ability to identify ethical dilemma, function on an interdisciplinary team, write well, formulate and implement

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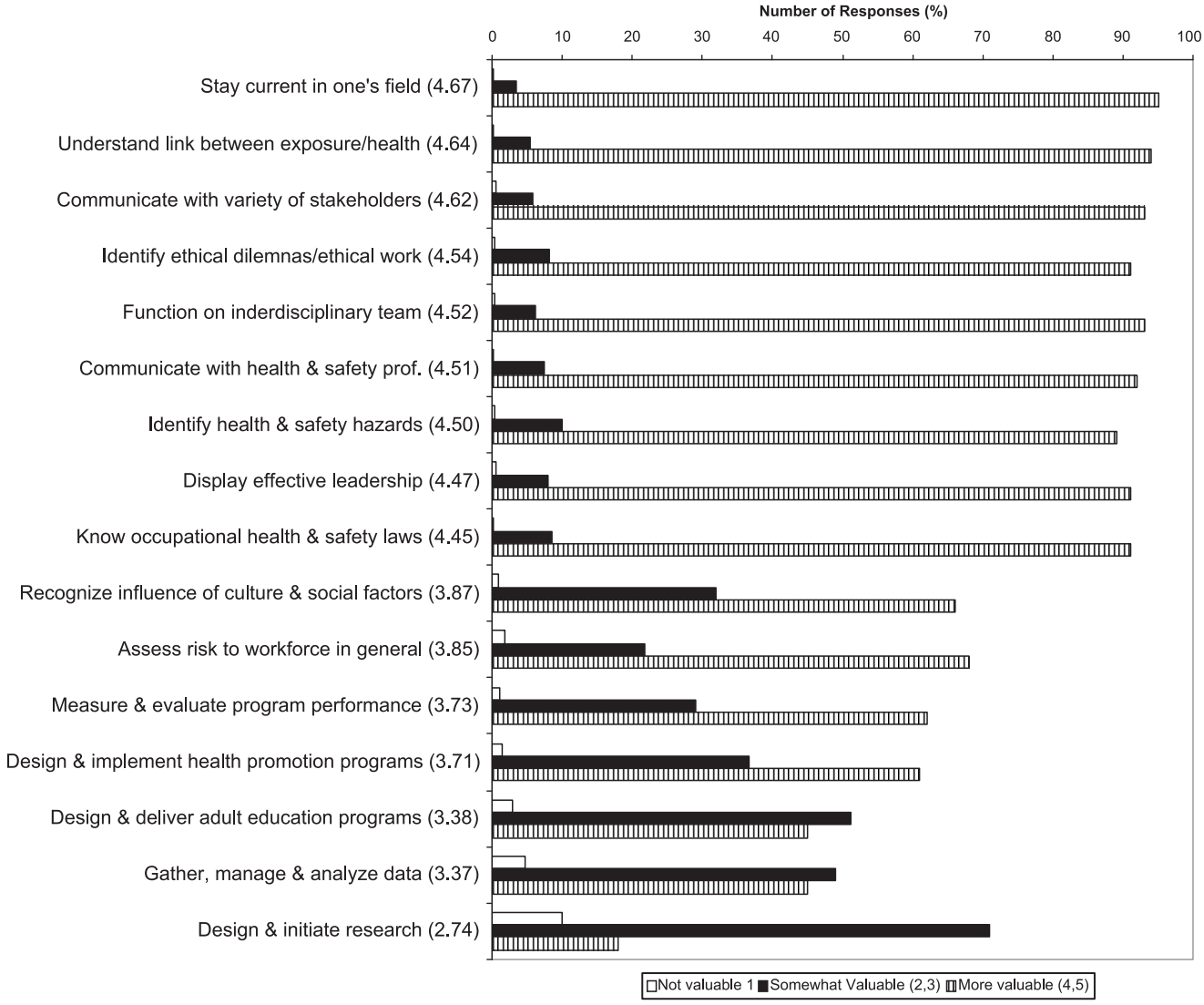

Fig. 1. Ranking of core competencies (mean values) in importance for the practice of OM and distribution of responses.

guideline, interpret scientific finding and disseminate policies, design and implement programs, etc, received significantly different ratings across the practice groups ($P < 0.05$).

Pairwise comparisons were performed for a variety of practice settings. Academic physicians rated designing and initiating research more highly than physicians in freestanding clinics ($P = 0.001$), multispecialty clinics ($P < 0.001$), consulting ($P = 0.011$), manufacturing ($P = 0.001$), and others ($P = 0.033$) did. Physicians in academic settings also rated the following core competencies higher than physicians in freestanding clinics did: gathering, managing and analyzing data ($P < 0.001$); assessing risk to workforce in general ($P < 0.0001$); applying scientific findings to specific problems ($P = 0.001$); and measuring and evaluating performance ($P < 0.001$). Academic physicians rated designing and implementing surveillance ($P = 0.008$) or screening programs ($P = 0.045$) more highly than physicians in freestanding clinics did.

Physicians who worked in freestanding clinics gave a lower rating to the ability to gather, manage, and analyze data than physicians in federal/state government settings ($P < 0.001$), performing consulting services ($P = 0.008$), or in academic positions ($P < 0.001$). Physicians in freestanding clinics also rated the ability to assess risk to workforce in general lower than physicians in federal/state agencies ($P = 0.022$), academic ($P < 0.001$), or manufacturing ($P = 0.006$) settings did. Physicians in freestanding clinics also gave a lower rating to the ability to interpret and apply scientific findings than physicians employed by federal/state agencies ($P = 0.007$), or engaged in consulting ($P < 0.001$) or academia did ($P = 0.001$). Physicians in freestanding clinics also rated the ability to measure and evaluate performance of programs or designing and implementing surveillance programs lower than academic physicians or those involved with manufacturing did ($P < 0.05$).

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TABLE 6
Core Competency Ratings With Statistically Significant Differences by Practice Settings: Means and Tests of ANOVA

	Overall Mean Score	Freestanding Clinic	Multispecialty Clinic	Federal/ State Agency	Consulting	Academia	Manufacturing	Other	*P* Value*
Identify ethical dilemmas and work in an ethical manner	4.54	4.38	4.60	4.63	4.54	4.80	4.54	4.58	0.019
Function effectively on a interdisciplinary team	4.52	4.38	4.54	4.56	4.42	4.68	4.52	4.65	0.027
Write well	4.34	4.28	4.16	4.74	4.60	4.43	4.30	4.26	<0.001
Formulate and implement policies	4.25	4.08	4.22	4.48	4.25	4.53	4.30	4.31	0.043
Develop and implement health and safety programs	4.19	4.01	4.12	4.41	4.20	4.50	4.26	4.20	0.032
Apply scientific findings to specific problems	4.09	3.78	4.03	4.44	4.38	4.45	4.20	4.08	<0.001
Interpret and disseminate policies	4.04	3.90	3.83	4.41	4.04	4.33	4.28	4.08	<0.001
Design and implement screening program	4.01	3.77	3.96	4.07	4.04	4.28	4.22	4.10	0.008
Design and implement surveillance programs	3.96	3.66	3.82	4.15	3.99	4.28	4.34	4.11	<0.001
Assess risk to workforce in general	3.85	3.50	3.74	4.15	3.90	4.28	4.06	4.00	<0.001
Measure and evaluate performance of programs	3.73	3.45	3.62	3.89	3.71	4.13	3.98	3.87	<0.001
Design and implement health promotion programs	3.71	3.51	3.84	3.52	3.61	3.63	3.86	3.89	0.019
Gather, manage, and analyze data	3.37	2.98	3.25	3.93	3.51	3.95	3.40	3.48	<0.001
Design and initiate research	2.74	2.54	2.58	2.93	2.80	3.45	2.54	2.89	<0.001

*P value for ANOVA of mean scores in different employment groups.
ANOVA indicates analysis of variance.

Physicians who worked in multispecialty clinics gave a lower rating to gathering, managing, and analyzing data than did those in federal/state agencies ($P = 0.042$) and in academia ($P = 0.004$). Physicians in multispecialty groups also rated the ability to write well lower than physicians in federal/state government agencies ($P = 0.005$) or consulting physicians ($P = 0.002$) did. Physicians in multispecialty clinics also rated the ability to interpret and disseminate policies lower than physicians in federal/state agencies ($P = 0.024$), academia ($P = 0.024$), or manufacturing ($P = 0.029$) did.

Physicians who were board certified in OM also gave significantly different ratings for some of the core competencies than did physicians who were not board certified (Table 7). The physicians who were board certified in OM placed more value on assessing workplace exposure risks; data analysis; designing, implementing, and assessing programs; and some management skills than did those who were not board certified (Table 7). The board-certified physicians also felt that understanding the relationship between occupational exposures and health outcomes ($P < 0.001$) and gathering, managing, and analyzing data ($P = 0.001$) were more important than those who were not board certified in OM did (Table 7). Physicians who were board certified in OM gave more value to communicating with a variety of stakeholders, writing well, interpreting scientific findings, and designing and implementing surveillance programs.

The ANOVA revealed significant differences in rating the importance of the core competencies among other subgroups of the respondents (Table 8). The OM physicians who had taken the OM board examination (group I = graduated from OM residency within the last 10 years; group II = did not graduate from OM residency within last 10 years and took the board examination) differed significantly in several aspects from those who did not graduate from an OM residency within the last 10 years and had not taken the OM board examination (group III). Groups I and II ranked the core competencies

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TABLE 7
Core Competency Scores According to Board Certification in Occupational Medicine (OM): Mean Score Values and *t* Tests for Difference of Means

	Board Certified in OM	Not Board Certified in OM	*P* Value
Stay current in one's field of practice	4.68	4.64	0.354
Understand the relationship between occupational exposures and health outcomes	4.71	4.53	<0.001
Communicate effectively with a variety of stakeholders	4.69	4.51	0.003
Identify ethical dilemmas and work in an ethical manner	4.57	4.48	0.134
Function effectively on an interdisciplinary team	4.56	4.44	0.025
Communicate effectively with other safety and health professionals	4.55	4.45	0.102
Identify health and safety hazards of work site processes and operations	4.52	4.47	0.419
Display effective leadership	4.52	4.41	0.066
Know occupational safety and health laws	4.50	4.39	0.046
Write well	4.43	4.19	<0.001
Formulate and implement guidelines and policies	4.33	4.15	0.013
Develop and implement health and safety programs	4.18	4.21	0.667
Manage staff/personnel resources effectively	4.15	4.13	0.757
Interpret and apply scientific findings to specific problems	4.19	3.92	0.001
Interpret and disseminate policies	4.10	3.92	0.009
Design and implement screening programs	4.08	3.91	0.024
Design and implement surveillance systems	4.06	3.83	0.007
Manage financial resources effectively	3.92	4.01	0.231
Recognize influence of cultural and social factors in occupational health and safety	3.86	3.88	0.897
Assess risk to the workforce in general	3.90	3.79	0.183
Measure and evaluate performance of programs	3.82	3.63	0.014
Design and implement health promotion programs	3.68	3.77	0.313
Design and deliver adult education programs	3.38	3.38	0.980
Gather, manage, and analyze data	3.48	3.19	0.001
Design and initiate research	2.77	2.70	0.442

**P* values reflect *t* tests for differences in means.

related to data and policy analysis, administration, and communication as more important than group III (Table 8). They explain most of the 14 competencies that were statistically significant in Table 8. Although there are also some noticeable differences between group I and group II, these differences tended to be statistically insignificant.

Knowledge Areas Important to Employers or Organizations

The OM physicians were also asked how important specific knowledge areas were in meeting the needs of their organizations or employers. The OM physicians were asked to rate: "How important is it that OM physicians working with your organization are knowledgeable about these areas?" on a scale of 1 ("not important") to 5 ("very important"). Three of the five most important knowledge areas for organizations employing OM physicians are also listed as core competencies by the ACGME for every type of medical practice: professionalism (77% of respondents classed as very important), interpersonal skills and communication (73%, very important), and patient care (65%, very important) (Fig. 2). Other areas of knowledge that were chosen as very important to their respective organizations by more than 50% of respondents included clinical occupational medicine (69.9%), and disability management and work fitness (63.4%) (Fig. 2). Less than 10% of the respondents felt that the following areas of knowledge were very important: aerospace medicine, biostatics, and health services administration (health care field) (Fig. 2). There was no statistic difference between those who had taken the OM board examinations and those who had not regarding how useful certain areas of knowledge and competencies were to their employers.

The importance of certain areas of knowledge and competencies correlated with types of employment settings and size of employers. The OM physicians employed in clinical settings (freestanding OM clinics [group I] or multispecialty clinics [group II] ranked direct patient-care skills higher than did those working in other settings (Table 9). The OM physicians working as consultants, with federal or state occupational or environmental health regulatory agencies, managed care/insurance, university academic centers, etc, gave a higher rating to skills related to population-level health.

The size of the OM physician's employer did not change what was considered important in knowledge and competency areas. Patient care was ranked highest by those who worked with organizations that have less than 50 employees (mean score = 4.69); mean values ranged from 4.43 to 4.51 for the other sizes (ANOVA for difference in means between groups, $P = 0.025$).

Discussion

Because OM lies at the interface between work and health,[14] it presents a unique opportunity to assess the importance of clinical medicine, toxicology, public health, preventive

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TABLE 8
Importance of Knowledge Areas to Employers Ranked by Type of Occupational Medicine (OM) Practice: Mean Score Values and Tests of ANOVA

	Group I	Group II	Group III	*P* Value*
Stay current in one's field of practice	4.71	4.67	4.64	0.608
Understand the relationship between occupational exposures and health outcomes	4.69	4.7	4.51	0.002
Communicate effectively with a variety of stakeholders	4.73	4.69	4.48	0.001
Identify ethical dilemmas and work in an ethical manner	4.47	4.59	4.5	0.207
Function effectively on an interdisciplinary team	4.59	4.53	4.46	0.225
Communicate effectively with other safety and health professionals	4.63	4.52	4.44	0.048
Identify health and safety hazards of work site processes and operations	4.50	4.53	4.44	0.423
Display effective leadership	4.60	4.50	4.38	0.027
Know occupational safety and health laws	4.55	4.49	4.36	0.035
Write well	4.49	4.41	4.16	0.000
Formulate and implement guidelines and policies	4.44	4.30	4.12	0.004
Develop and implement health and safety programs	4.26	4.17	4.18	0.649
Manage staff/personnel resources effectively	4.29	4.11	4.12	0.123
Interpret and apply scientific findings to specific problems	4.23	4.18	3.88	0.000
Interpret and disseminate policies	4.29	4.06	3.85	0.000
Design and implement screening programs	4.15	4.07	3.86	0.014
Design and implement surveillance systems	4.07	4.06	3.79	0.006
Manage financial resources effectively	4.06	3.90	3.98	0.275
Recognize influence of cultural and social factors in occupational health and safety	4.03	3.81	3.85	0.126
Assess risk to the workforce in general	4.10	3.85	3.74	0.007
Measure and evaluate performance of programs	3.83	3.82	3.58	0.015
Design and implement health promotion programs	3.81	3.67	3.73	0.434
Design and deliver adult education programs	3.48	3.35	3.37	0.473
Gather, manage, and analyze data	3.54	3.46	3.15	0.001
Design and initiate research	2.92	2.71	2.68	0.113

Group I ($n = 106$): Physicians who graduated from residency program in the last 10 years (almost all had taken the board examination for OM).

Group II ($n = 286$): Physicians who did not graduate from residency program in the last 10 years and took board examination in OM.

Group III ($n = 204$): Physicians who did not graduate from residency program in the last 10 years, but did not take board examination in OM.

*P values for ANOVA tests of differences between groups. Pairwise comparisons of the group means (with Bonferroni adjustment) were also performed. Most statistically significant differences were for group III versus group I and for group III versus group II.

ANOVA indicates analysis of variance.

medicine, epidemiology, and administration competencies and knowledge. In this survey, we assessed the demographic profile and opinions of current OM physicians who are members of ACOEM on the importance of specific core competencies in their practice.

The overall response rate of 40.6% is high for surveys of this type, and much higher than that usually achieved for marketing or opinion surveys. In a comparable study, Jepson and colleagues[20] obtained a response rate of 38% when mailing questionnaires of similar length (more than 1000 words) to a sample of generalist physicians randomly selected from the American Medical Association's master file. Physician responses to surveys are often lower than for other groups. However, our relatively low response rate compared with many other types of epidemiological surveys raises the issue of possible selection bias and limited generalizability of the findings.

To address possible selection bias, we examined ACOEM membership data relating to all its physician members. The number of physicians who completed another postgraduate degree was similar for the study participants and all ACOEM physician members, although more study participants were board certified in occupational medicine (60.3% vs 41.5%) (Table 1). These differences may be due to differences in data collection because ACOEM information about other board certification or postgraduate degrees is only routinely collected when the physician initially applies and may well be incomplete. ACOEM members can review their membership listing online and update the information, or the data may be updated if they become a fellow, but this is likely to be incomplete. Many OM residents are encouraged to join ACOEM when they are residents and before they become board certified. Possibly, some of them do not update the directory information after board certification. It is also possible that board-certified OM physicians identified more with the specialty and thus were more inclined to complete the survey. It is unclear, however, whether the difference in rates of board certification would have biased the results of the study. ACOEM was unable to provide comparable data about practice settings. The observed difference in board certification and postgraduate degrees among our respondents relative to the overall physician membership of ACOEM may limit the generalizability of study results to the entire ACOEM membership.

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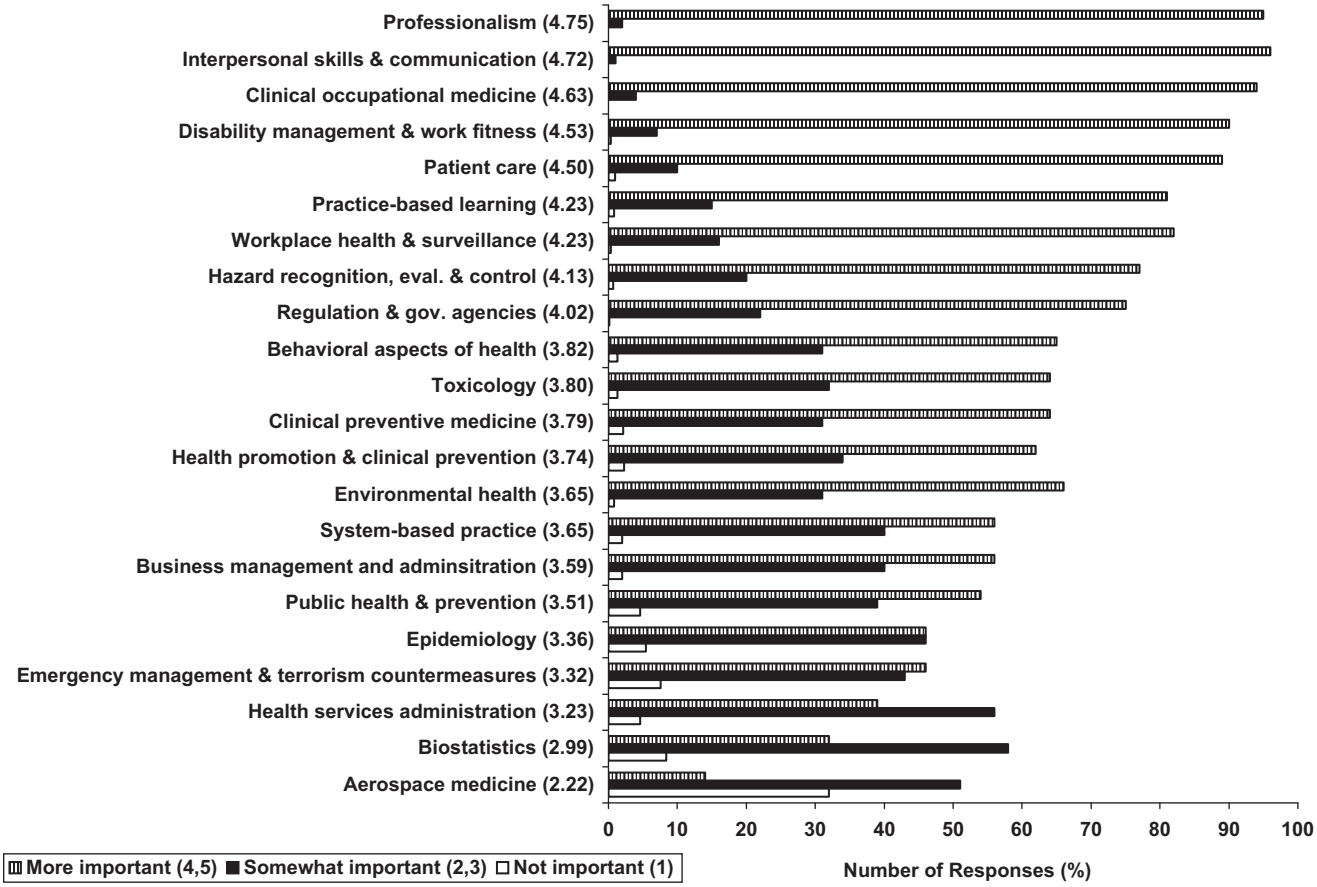

Fig. 2. Ranking of core competencies (mean values) in importance for employers of OM physicians and distribution of responses.

Most ACOEM physicians who responded to the survey were board certified in OM. Some differences of opinion were found between board-certified OM physicians and physicians who were not. Physicians who were board certified in OM were more satisfied with their specialty than those who were not (Table 2). The OM board-certified physicians placed more value on assessing workplace exposure risks; data analysis; and designing, implementing, and assessing programs than did those who were not board certified (Table 7).

Occupational medicine appears to be a mature specialty, with 80% of the surveyed OM physicians having completed other postgraduate degrees (38% with an MPH, 1.1% with a PhD, 0.8% with a JD) or completed additional residency programs (Table 1). Sixty-eight percent of OM physicians were board certified in other specialties. OM physicians may enter the field later in life or after they have become board certified in another area. This supports the assessment by Harber and Ducatman[12] that many OM physicians enter the specialty after they have practiced in other specialties. Training in other specialties may certainly enrich their medical knowledge, core competencies, ability to formulate patient treatment plans, deal with complex issues, and make decisions that improve the health and safety of the worker.

The OM physicians worked in a variety of employment settings. Half of them surveyed worked in a clinical setting (Table 3). The most common employment setting was a freestanding OM clinic (25.2%), followed by multispecialty clinics/hospitals (18.9%) and consulting firms/self employed (11.5%). These data support the trend observed by other authors of fewer corporate-based OM physicians and more who were in clinic-based practice.[3–5,13]

The evaluation of core competencies and core knowledge areas offers insights into what competencies are considered important by OM physicians. This survey did not attempt to measure the actual levels of competence in each core competency—these are always difficult to measure—but, instead, assessed the physicians' impressions of what core competencies were considered the most important for their practice. These OM physicians valued core competencies related to hazard recognition, behavior, and communication most highly (Fig. 1). Also, they thought that OM practice requires effective communications and being able to function on an interdisciplinary team to protect the health and safety of the worker.

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TABLE 9
Importance of Competency and Knowledge Areas to Employers, According to Type of Occupational Medicine Practice: Mean Score Values and Tests of ANOVA

	I	II	III	IV	V	*P* Value*
Professionalism	4.74	4.79	4.75	4.67	4.76	0.425
Interpersonal skills and communication	4.72	4.77	4.65	4.7	4.72	0.626
Clinical occupational medicine	4.77	4.75	4.54	4.44	4.61	0.000
Disability management and work fitness	4.59	4.61	4.40	4.44	4.53	0.162
Patient care	4.76	4.74	4.29	4.36	4.29	0.000
Workplace health and surveillance	4.05	4.23	4.14	4.22	4.44	0.000
Practice-based learning and improvement	4.32	4.46	4.10	4.06	4.15	0.001
Hazard recognition, evaluation, and control	3.97	4.14	4.12	4.06	4.31	0.012
Regulation and government agencies	3.91	4.02	3.99	3.99	4.14	0.129
Behavior aspects of health	3.77	3.93	3.65	3.82	3.85	0.376
Toxicology	3.67	3.94	3.93	3.61	3.9	0.018
Clinical preventive medicine	3.70	3.8	3.74	3.82	3.86	0.638
Environmental health and risk assessment	3.68	3.77	3.71	3.71	3.87	0.348
Health promotion and clinical prevention	3.62	3.90	3.49	3.86	3.77	0.019
Environmental health	3.50	3.68	3.64	3.62	3.8	0.138
Systems-based practice	3.65	3.72	3.35	3.48	3.84	0.001
Management and administration (general business)	3.50	3.69	3.49	3.61	3.63	0.462
Public health and prevention principles	3.27	3.52	3.45	3.58	3.68	0.010
Epidemiology	3.05	3.22	3.70	3.44	3.55	0.000
Emergency management and terrorism countermeasures	3.10	3.07	3.29	3.54	3.57	0.000
Health services administration (health care field)	3.05	3.41	3.13	3.32	3.23	0.040
Biostatistics	2.60	2.91	3.19	3.13	3.25	0.000
Aerospace medicine	2.12	2.25	2.19	2.38	2.19	0.449

Group I (n = 153): Freestanding OM clinic.
Group II (n = 115): Multispecialty clinic/hospital.
Group III (n = 70): Consulting company or self-employed.
Group IV (n = 104): Other (unspecified).
Group V (n = 165): Other varied (integrated or managed care, health insurance, federal or state occupational or environmental health regulatory agency, federal or state employee health services, university academic position, university employee health services; agriculture, forestry, fishing; construction, mining, manufacturing, service industries).
*P values for tests of ANOVA.
ANOVA indicates analysis of variance.

A prior European survey of OM physicians[10] found mean scores for some of the core competencies that were similar to mean scores in our study: identifying occupational hazards to health (4.5), occupational health law and ethics (4.2), communications (4.2), research methods (4.0), health promotion (3.6), disability assessment (3.9), environmental medicine (3.5), and management (3.5).[10] The European physicians rated understanding occupational hazards to health, occupational health law and ethics, and communications highly, just as American OM physicians did. Research methods were rated higher by European physicians (3.5) than by US physicians (2.7). Management competencies received the lowest rating by the European OM physicians, which may reflect the fact that most European OM physicians continue to focus on disease management and hazard recognition.

The OM physicians' rating of how important specific core areas of knowledge were for their employers or organizations were used as a proxy for their employers' response. The OM physicians were felt to be the group that could best assess what core competencies were most valued by their institutions or organizations. The OM physicians felt that professionalism, interpersonal skills and communication, and patient care were "very important" areas of knowledge for their organizations (Fig. 2). These three competencies are also part of five major core competencies listed by the ACGME for all medical practice, confirming that most ACGME major core competencies are relevant to OM practice. Other areas of knowledge that were chosen as "very important" to their respective organizations by more than half of the physician respondents included clinical occupational medicine, disability management, and work fitness (Fig. 2).

A UK survey in 2005[11] noted that the core competencies most important for physicians were also important for their employers and employees. This survey included employers, employees, and union representatives who rated the following core competencies in order of decreasing importance: law and ethics, occupational hazards, disability and fitness for

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work, communication, environmental exposures, research methods, and health promotion and management.[11] The list of core competencies in the UK study differed from the list of core competencies and areas of knowledge in our study. Our survey did not directly contact employees or employers, and further investigations would help determine what OM core competencies and areas of knowledge are most important for these groups.

Results of this study may help guide future discussion on alternative or additional OM training needs. For example, OM training programs and funding agencies may choose to revise their curricula to facilitate increased coverage of core competencies and areas of knowledge considered most important to OM physicians and their employers. The National Institute for Occupational Safety and Health (NIOSH) has often emphasized the need to train OM physicians to do research, but the ability to design and initiate research was ranked as "very important" by less than 4% of OM physicians; 43.7% ranked research as "moderately valuable," and 10.0% ranked research as "not valuable" (Fig. 2). However, many OM physicians felt that the ability to "gather, manage, and analyze data" and measure and evaluate performance was important. However, although "research" as narrowly defined was not highly valued by many clinical OM physicians, proficiency on evaluating both data and performance, which is often learned or employed in research studies, was considered important. Because the NIOSH is the primary source of US funds for OM resident training, more emphasis on clinical training may be appropriate, given the results of the present survey.

We conclude from the present findings that OM physicians appear to be highly trained, with 60.3% board certified in OM and 68.0% board certified in other specialty areas. The OM physicians valued core competencies related to hazard recognition, behavior, and communication most highly. Professionalism, interpersonal communications, and clinical occupational medicine were ranked as most valuable for OM employers. These observations provide guidance for the content of OM residencies and training programs, suggesting that more emphasis be placed on career development skills. Job satisfaction among OM physicians appears to be high, as 80% of the physicians surveyed would "probably" or "definitely" select OM again as a specialty (Table 2). This is encouraging for the future of the specialty and the field of OM. Further studies are needed to characterize the needs and demographics of the OM physician more effectively. An assessment of customer or patient satisfaction and the patient's assessment of core competencies and areas of knowledge would be useful future studies.

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