The Occupational Medicine Pipeline

Report on the Results of a Survey of International Occupational Medicine Society Collaborative (IOMSC) Member Countries

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Objective: To learn how occupational and environmental medicine (OEM) expertise is developed and maintained around the world and to inform strategies for further international development of OEM. **Methods:** An anonymous survey was conducted of leaders of the 48 member societies (from 43 countries) of the International Occupational Medicine Society Collaborative (IOMSC) to evaluate OEM training, certification, maintenance, and recertification requirements. **Results:** OEM physician leaders representing 46 of the 48 IOMSC member societies (95.8%) completed the survey between December 2019 and February 2020. Academic postgraduate and on-the-job training were the most frequent methods for developing OEM expertise, with little use of online coursework and minimal OEM content in medical school in most countries. Occupational medicine board certification usually required graduate specialty training and passing a certification examination, while occupational medicine recertification requirements were uncommon. **Conclusion:** The IOMSC is positioned to support the international development of OEM expertise by sharing information on competencies, best practices in medical education curriculum content and examples of OEM specialty certification pathways from different countries.

Keywords: Medical education, international, occupational medicine, residency

Occupational and environmental medicine (OEM) physicians serve essential roles in protecting and promoting the health, safety, and wellbeing of workers, and in improving workplace environments. Their roles vary widely and include direct patient care, employee health management, research, and public health policy development. Challenges in making occupational medicine physicians more widely available to employers, workers, and public health agencies include a supply deficit in practicing OEM physicians and a large variation in OEM training and practice patterns around the world.

OEM physicians serve as a bridge between individual care and population-based occupational health. The specialty of OEM also has an essential role in public health. Recently, OEM physicians have had a central role in the COVID-19 pandemic public health response. The COVID-19 pandemic has amplified the need for OEM expertise from the highest levels of planning public health responses to the ground-level care of front-line workers needing appropriate respiratory protection and safe return-to-work strategies. OEM physicians are the experts in protecting workers' safety, mitigating risk to essential workers, evaluating fitness to work, and supporting safe return to work. The complex and ever-changing nature of workplace challenges have been further exacerbated by the COVID-19 pandemic. OEM physicians speak the language of medicine as well as the language of business, thus are best prepared to navigate various scenarios unique to specific industries and to tailor risk mitigation strategies for each workplace.

In the United States (US), occupational medicine is a board-certified specialty under the American Board of Preventive Medicine. Historically, OEM physicians focused on the diagnosis and treatment of work-related injuries and illnesses. However, this mission has evolved over time. The American College of Occupational and Environmental Medicine's (ACOEM) vision is to strengthen communities and workplaces by ensuring worker health, safety, wellbeing, and fostering a healthful environment.[1] The increasing age of the working population, the multinational reach of many employers, changes in the types of work and complex legislation have all contributed to the expansion of the scope of OEM practice. OEM physicians have become the leading experts in the complex web of factors that affect health in the workplace, helping organizations ensure the health of their employees, optimizing human performance in the workplace, and advancing the overall economy. There is evidence that companies that pay attention to occupational health and safety indicators also thrive in the stock market.[2]

In the United States, there are currently only 25 accredited occupational medicine residency programs, and at least 18 occupational medicine programs have closed since 2000; this trend seems to have leveled.[3] The US residency training pathway requires a physician to undergo one year of internship and two years of occupational medicine residency training. Within the two-year residency training, residents spend approximately one year completing a Master of Public Health (MPH) degree. Occupational medicine training discussions have focused on too few well-trained occupational medicine physicians to meet workforce needs.[4,5] There are too few funded training positions available, and the cost of training residents is high.[3] There are also significant differences in the content, focus, and methods of training among residency programs and alternative pathways to board certification or other designation of relevant expertise in the United States.[6] OEM remains unusual in that a minority of physicians delivering related services are board-certified in the specialty.[3] Also, the pool of well-qualified applicants is limited. Many physicians enter

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the discipline laterally after practice in other areas of medicine. Without formal occupational medicine training, one may not have required depth and scope of practice to be successful in complex OEM-related decision making.

There has been work in the European Union (EU),[7] Australia,[8] United Kingdom,[9] and Brazil[10] to define OEM training requirements and competencies, but little is known about the different pathways to OEM expertise on an international scale. An article from Italy outlines the pathway to occupational medicine certification recognized elsewhere in the EU, describing how two alternative pathways previously used by physicians trained in public health medicine or legal/forensic medicine were no longer recognized as sufficient for EU occupational medicine certification reciprocity.[11] A scoping review of approaches to meeting the public health delivery needs, including occupational health, in the European region identified nine comparative measures to consider when planning to meet these needs.[12]

The International Occupational Medicine Society Collaborative (IOMSC) was established in 2013 to build stronger collaborative relationships between occupational medical societies and faculties that represent the physicians and other health professionals who promote the health of workers around the world. Based on the IOMSC survey on global trends in OEM, the following are the 10 most commonly listed activities for OEM physicians in descending order: occupational health-risk/targeted screenings; traditional occupational injury/illness management; primary health care; return-to-work examinations; pre-employment examination; administrative duties; general health screenings; workers' compensation; health promotion/disease prevention; and evaluation of worksite environment.[4] Another international survey in 2016 established a high level of consensus among occupational physicians about the common competencies required for OEM practice.[13] In this modified Delphi study, occupational physicians ranked the following competencies as most important to the specialty: good clinical care; assessment and management of occupational hazards; assessment of disability and fitness for work; communication skills; ethical and legal issues; teamwork and leadership; assessment of environmental health issues; health promotion; clinical governance/improvement; management; teaching; and research. These overlap well with the OEM competencies established by ACOEM,[14] which are not organized in order of priority: clinical occupational and environmental medicine; OEM related laws and regulations; environmental health; work fitness and disability management; toxicology; hazard recognition, evaluation and control; disaster preparedness and emergency management; health and human performance; public health, surveillance, and disease prevention; and OEM related management and administration.

Most of these competency areas are not addressed in medical school or in residency training other than occupational medicine specialty training. Yet, most of the physicians providing OEM care are not occupational medicine residency trained or board certified.[15]

An international survey of occupational medicine societies in 2017 noted that the shrinking pool of available occupational medicine physicians is a global concern, as the current OEM training pipeline is not sufficient to replace aging OEM physicians; this gap appears to be widening over time.[4] Another international survey by the International Commission on Occupational Health (ICOH) in 2017 noted that on average, 80% of the total working population in the world do not have access to occupational health services.[5]

In collaboration with the IOMSC leadership, the goal of this survey was to learn how OEM expertise is developed and maintained around the world and to identify gaps and opportunities that might be addressed by increased international collaboration. It was also designed to identify best practices that may be studied and shared with other countries interested in developing more OEM expertise.

METHODS

Data Collection

The survey tool was generated using Qualtrics XM software (Qualtrics, Provo, UT). The questionnaire collected basic demographic information such as country name, OEM society name, and verification of OEM society leadership role. The 10 survey questions centered on five elements including: OEM education within the medical school curriculum; OEM residency training requirements; ways of developing OEM expertise; OEM board certification, maintenance, and recertification; and work tasks requiring OEM certification. The survey instrument used branching logic. There were several strategically embedded open-ended questions for the participants to further explain or elaborate on the subject. The survey included a final open-ended question regarding the routes to OEM expertise in the country. The survey instrument is in Appendix 1, http://links.lww.com/JOM/B28.

Recruitment

The project was classified as non-human subjects research by the University of Maryland Baltimore Institutional Review Board. The survey collection period was from December 12, 2019 through February 15, 2020. The inclusion criteria were OEM society leaders within the IOMSC, which includes 48 societies in 43 countries (Table 1). An OEM society leader is in general an OEM trained physician, an active member of the society, and considered an expert in the field of OEM in that country. The authors included two IOMSC leaders who forwarded the survey link to each society and requested that a society leader complete the survey. To maintain anonymity, we did not control or collect information on who completed the survey. If an OEM society represents several different countries, participants were asked to fill out the questions for each country separately. To increase the response rate, email reminders were sent several weeks after the initial invitation. The questionnaire did not collect any individual identifiable information or protected health information.

Statistical Analysis

Descriptive summary statistics were used to characterize the study population, using sum and percentages for categorical variables such as OEM content in medical school curriculum; OEM residency training requirements; ways to develop OEM expertise; board certification requirements; and types of OEM activities that require board certified physicians. During data analysis, each country was represented only once in the section regarding board certification, maintenance, and recertification. Only countries with requirements for initial board certification were included in the

TABLE 1. IOMSC Member Countries

Argentina	Japan
Australia	Macedonia
Brazil	Malaysia
Canada	Netherlands
Chile	New Zealand
China	Nigeria
Colombia	Norway
Costa Rica	Peru
Croatia	Philippines
Denmark	Portugal
Egypt	Qatar
Estonia	Russian Federation
France	Singapore
Germany	Slovakia
Greece	South Africa
Guatemala	South Korea
Honduras	Switzerland
India	United Arab Emirates
Indonesia	United Kingdom
Republic of Ireland	United States
Italy	Venezuela
Ivory Coast	

IOMSC, International Occupational Medicine Society Collaborative.

analysis of board maintenance, recertification, and types of activities that require a physician certified in OEM. For questions pertaining to OEM residency training document requirements, only countries with OEM residency were included in the analysis. To determine association between board certification requirement, income level, and OEM training requirements, statistics included chi-square tests for categorical variables, and Mann–Whitney *U* test for continuous variables with nonparametric data. *P* values <0.05 were considered statistically significant. All analyses were performed using Stata statistical software (StataCorp LLC, 2019).

RESULTS

Baseline Characteristics

Forty-six of the 48 IOMSC member societies completed the questionnaire, for a 95.8% completion rate. During the survey period, IOMSC leadership received requests from Oman and Sudan OEM society leaders to also participate in the survey. Although they were not IOMSC society members, the leadership welcomed their participation. Survey answers from the Russian Federation and United Arab Emirates had too many incomplete answers and were excluded from data analysis. Survey answers from China were excluded because the responder was not an OEM society physician leader. Some countries have more than one OEM society within IOMSC, and in some cases we received more than one response from different leaders in the same society. Therefore, more than one response was received from Australia, Greece, Italy, Ivory Coast, New Zealand, Nigeria, Qatar, Slovakia, and the United Kingdom. Ultimately, analysis included 50 respondents representing 40 countries from the following regions: Europe & Central Asia (34%), East Asia & Pacific (20%), Latin America & Caribbean (22%), Sub-Saharan Africa (10%), Middle East & North Africa (5%), North America (5%), and South Asia (3%).

Based on the World Bank income level categories, 33 out of 40 countries are considered upper middle or high income. The responding countries were further stratified by human development index (HDI), which is used as a marker of human development that captures life expectancy, education, and gross domestic product (GDP). As described by the United Nations Development Program: "The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions."[16] HDI measures each of those factors between zero and one, one being the best. It is a more comprehensive indicator of the wellness of a country.[17] Most of the responding countries have a relatively high HDI with the mean HDI of 0.784. Figure 1 illustrates responses based on responding country's HDI.

OEM Content in Medical School Curriculum

Respondents reported OEM content in medical school curriculum is uncommon (Fig. 2). However, some respondents reported incorporation of OEM education in core curriculum. Of those who reported including OEM content in core medical school curriculum, 28.6% reported medical school courses in OEM; 22.4% reported lectures on occupational illness; 18.4% reported lectures on OEM topics; 14.3% reported availability of clinical rotations in OEM for medical students; and 8.2% reported medical student opportunities in OEM research and quality improvement projects.

Twelve countries, including the United States, reported all five educational methods are uncommon in medical school curriculum. Based on the comments, some reasons for not incorporating these methods included a large variation between medical schools within the same country, lack of integrated national approach despite efforts to develop OEM topics in the medical school

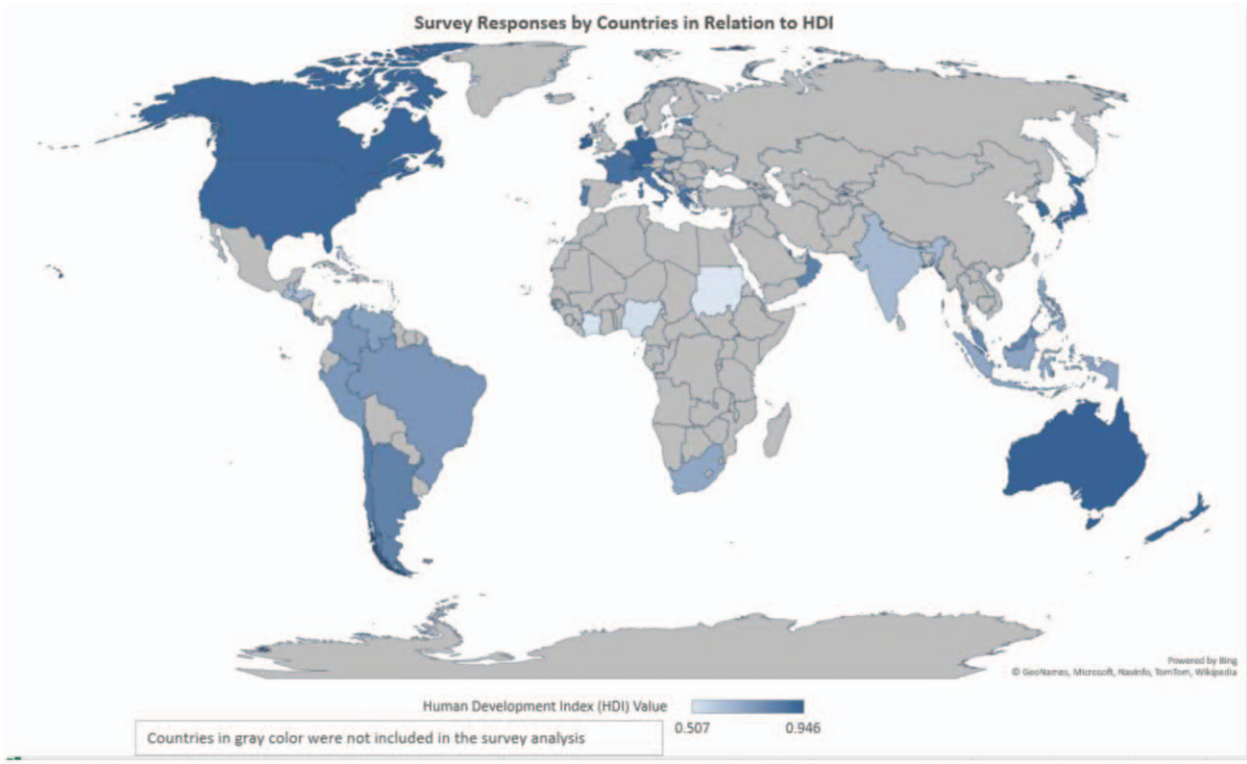

FIGURE 1. Survey responses by countries in relation to human development index (HDI).

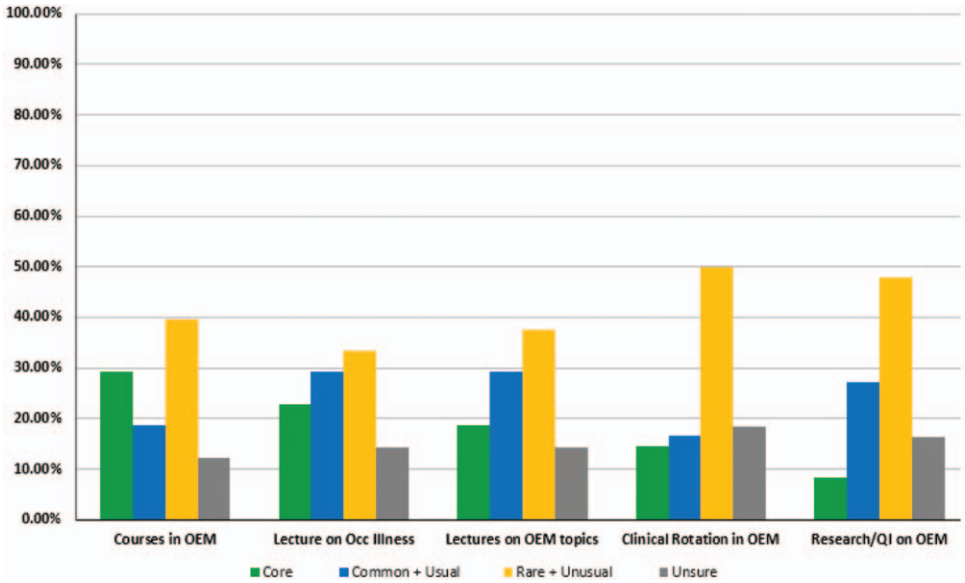

FIGURE 2. OEM related education in medical school curriculum ($n = 48$). OEM, occupational and environmental medicine.

curriculum, and lack of clear OEM education framework to gain student interest in the specialty.

Four countries, including Croatia, France, Indonesia, and Macedonia reported that all five educational methods are incorporated in their core medical school curriculum. Of note, those countries all have OEM board certification requirements. Comments indicated that topics included workplace risk assessment; work ability; prevention and health promotion; work-related stress; and occupational carcinogens. Teaching formats such as field work, group work, literature review, clinical practices, seminars, and presentations are utilized. The research team verified this information in follow up conversations with society leaders in the four countries. Information shared by OEM society leaders in these countries included how the curriculum was orchestrated; details about curriculum content; OEM competencies in the context of other public and community health requirements, and details about training requirements in OEM for allied health professionals as well as medical students.

Occupational Medicine Residency Training Requirements

Participants were asked about the availability of residency training in OEM in their countries. Forty respondents representing 35 countries reported that there are post-medical school residencies in OEM.

Most respondents (67.6%) reported that OEM residencies within their country are four to five years in duration. Four reported 3-year training requirements and four reported 2-year residency duration within their countries. Almost all the respondents indicated their occupational medicine residents are required to produce specific work documents during their training. The most common requirements were a work hazard prevention and mitigation report (100%) and risk or health hazard assessment (100%), followed by work causation evaluation (94.3%), risk communication (88.6%), work disability evaluation or rating (85.7%), and return to work program (82.9%). Many survey respondents stated there are other work document requirements during occupational medicine residency training. Common additional requirements include research presentation, worksite assessment, OEM and subspecialty clinical rotations, health surveillance, and health promotion programs.

Resources for Physicians to Develop Expertise in OEM

Participants were asked how physicians providing occupational health services in their country learn about OEM. Among all respondents, the most important methods for developing expertise in OEM were academic OEM training and on-the-job training (Fig. 3). Sixty-eight (68%) percent of respondents from higher income countries and 62.5% of respondents from lower income countries placed strong value in academic training. Respondents from lower income countries were more likely to value on-the-job training (62.5%) compared with respondents from higher income countries (45%). More respondents from lower income countries (37.5%) also reported formal OEM training abroad was important than respondents from higher income countries (15%). Based on the answers to open-ended questions, respondents from countries in early stages of OEM specialty development more often obtain OEM education abroad, and one respondent reported the need to import trained OEM physicians from overseas. Of interest, online coursework was least important to respondents in both higher and lower income countries. Many society leaders reported special qualification or certificate programs for non-specialists to learn basic OEM or job-specific OEM principles in their country. For instance, Canada created a year-long distance learning foundation course (with 2 days of face-to-face meeting) in occupational medicine for family physicians interested in OEM. A society leader from the Philippines reported an 8-day basic course in occupational medicine. Some countries reported requirements for testing and certifying competency to perform specific types of examinations (eg, radiation work, commercial driving, maritime work).

OEM Board Certification, Maintenance, and Recertification

Society leaders representing 29 countries (74.4%) reported a mechanism for OEM specialty board certification. More higher income countries (75.8%) have board certification requirements compared with lower income countries (57.1%), but the difference was not statistically significant. The low representation of society leaders from lower income countries in this

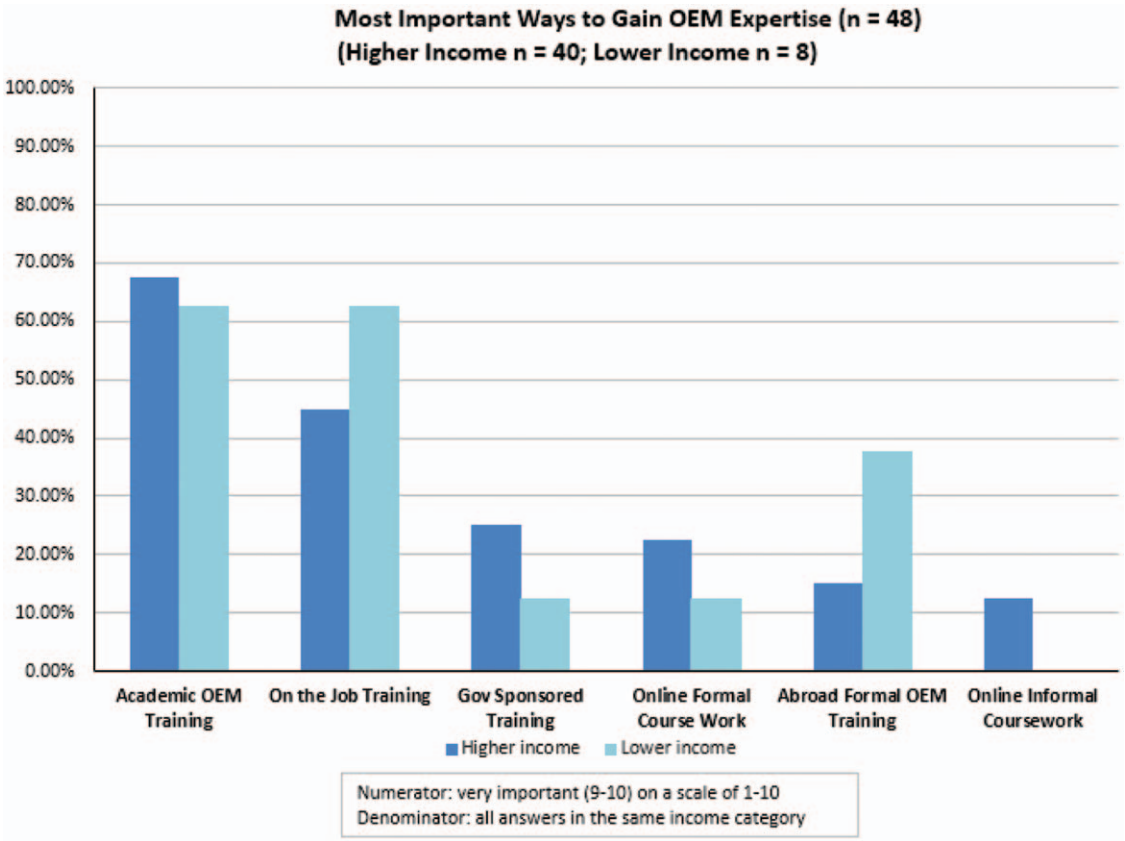

FIGURE 3. Most important ways to gain OEM expertise. OEM, occupational and environmental medicine.

study (only seven were categorized as low or low middle income) made such comparisons difficult. While there was no significant association between the country's income level and having an OEM certification board, there was a significant positive correlation between board certification availability and HDI, using the Mann–Whitney *U* test for unpaired data ($P = 0.0235$).

Within countries with OEM certifying boards, 82.8% reported requiring an OEM certification exam as a prerequisite. Of the 29 countries with board certification requirement, only the United States and Croatia reported requiring periodic recertification tests, while about a quarter reported requiring completing activities to illustrate competency to maintain certification and another quarter reported requiring periodic educational modules to maintain certification. Society leaders representing the Netherlands and Venezuela reported requirements to pass an external audit or review in addition to periodic education modules for OEM certification maintenance.

Tasks Requiring Certified OEM Physician

Participants were asked what tasks in their country required board-certified occupational medicine physicians to perform. Based on the responses received, there was concern that the question was misinterpreted and was therefore excluded from analysis.

DISCUSSION

To our knowledge, this is the first study on OEM training and credentialing on an international scale. It involved 48 OEM society leaders from 43 countries with response from 95.8% of the IOMSC member societies. Two non-IOMSC member OEM societies from Oman and Sudan also participated in the survey.

Medical School OEM Content

The first area of opportunity for increasing OEM knowledge is via the medical school curriculum and it is encouraging to see some countries incorporate OEM education into the core medical school curriculum. Early exposure to OEM topics is critical so medical students can consider OEM as a full-time career. More importantly, because the bulk of OEM services are delivered by clinicians who are not trained or board-certified OEM physicians, the best way to prepare the range of non-OEM specialist physicians is to reach them while they are still in medical school. Early exposure should increase their appreciation of the importance of workplace health and safety and help them link illness and work hazards. There are several published examples of medical school curriculum models. The UK Faculty of Occupational Medicine (FOM) developed an undergraduate teaching model that consisted of interactive lectures outlining the OEM core competencies, seminars for detailed discussion of common occupational diseases, workplace site visits, ethical and legal considerations, an OEM focused test, and an OEM objective structured clinical examination (OSCE) to assess competency.[15] The leaders of the OEM societies reporting core medical school curriculum in this study (Croatia, France, Indonesia, and Macedonia) were happy to share details about their curricular models.

Consideration: *The IOMSC may learn from the OEM societies which responded that OEM is included as core medical school content and share their curricular models.*

OEM Residency Training

In countries with OEM residency programs, almost all respondents reported training requirements in work hazard prevention, risk or health hazard assessment,

and work causation evaluation. More than 80% also have training requirements in risk communication, work disability evaluation, and return to work program development. Some countries, especially those with a lower HDI, reported that OEM is still in the early phases of development as a formal specialty. Many countries working on developing OEM as a specialty are partnering with either universities in their country or with colleagues in other countries. There are many differences in how physicians enter the field of OEM:

- Some countries reported that OEM training was offered as a subspecialty fellowship after first specializing in another field, such as internal medicine.
- Some respondents reported that some components of the OEM training program may be waived if the resident has completed training in certain specialties.
- Many countries reported that there is more than one pathway to OEM specialty designation.
- One country reported that occupational health specialty designation was open to a variety of professions, including nonhealthcare providers.

Consideration: The IOMSC may consider facilitating partnerships between societies in countries with established programs and those in the process of building the specialty.

Developing OEM Expertise

Effective and accessible educational methods are crucial to the development of OEM expertise. Driven by the aging working population, emerging new work hazards, increasing complexity of laws and the global workforce of many organizations, the knowledge requirements for OEM physicians continue to expand. The most important educational approaches reported in this survey were academic OEM training and on-the-job training. How can such education be delivered in countries without established academic programs, or where OEM specialist mentoring is rare? Many respondents (37.5%) from lower income countries placed great importance on formal OEM training abroad. Several countries reported partnerships between OEM medical societies, governments, and universities to provide required continuing OEM medical education.

Other interesting models bring together experts from other countries with learners in intensive in-person courses. Three innovative programs in Germany, Italy, and Thailand feature interdisciplinary networking, worksite walkthroughs, and other experiential learning approaches.[18] Another example of multinational cooperation brings together experts from countries with established OEM practices and professionals in countries with specific occupational health projects to solve. Such ''twinning'' projects between EU countries and developing countries require cooperation at the government level.[19]

Online formal and informal course work was less valued by respondents in this survey; however, it should be noted that the timing of this survey was just before the COVID-19 pandemic, and it is possible that attitudes about online learning have changed since the time the survey ended. The pandemic forced the rapid adoption of online meeting and educational platforms across the world. In fact, many OEM residency programs were forced to quickly make use of virtual learning experiences during the COVID-19 pandemic. In many cases, the virtual learning experiences enriched the learning environment and improved access to speakers and rotations. With technology advancement and increased use of virtual platforms, OEM educators can offer national and international level training courses to a wider audience. Online training is a viable and cost-effective approach to extend the current training methods. Virtual learning also offers a solution to a challenge some learners face in obtaining a visa and sponsorship, which may be required for in-person training abroad.

One potential challenge to the adoption of international virtual educational offerings is that country-specific educational accreditation requirements may prevent international learners from obtaining needed education credits for training from other countries. A standardized approach to reviewing and documenting the educational content of offerings may provide an eventual solution. New and existing global mentorship for OEM training platforms will further expand occupational health services for the workforce.

Consideration: The IOMSC may consider developing a platform for sharing information about OEM educational activities to foster international access and networking.

Board Certification in OEM

Seventy-four percent (74.4%) of the countries represented in this survey reported a mechanism for OEM specialty board certification. An analysis funded by the National Institute for Occupational Safety and Health (NIOSH) showed OEM board certified physicians had more diverse practice activities and skills and were more involved in management and public health-oriented activities, with greater emphasis on toxicology.[20] In countries with board certification, requirements in initial OEM board certification were similar: graduation from medical school; completion of occupational medicine residency or fellowship; and passing a certification examination.

Only about a quarter of the countries with OEM certification require Maintenance of Certification (MOC) or recertification. Most recertification requires periodic education, with very few requiring a recertification examination or external audit system. Per society leaders' responses, the United States is one of the two countries in this survey that requires a periodic recertification examination. In the United States, there is a limited amount of research on the outcome value of board recertification in any specialty. In a literature review regarding MOC in emergency medicine, existing research ''fails to address whether MOC activities enhance the quality of care or practitioner competency or whether they improve patient outcomes.''[21] In a study regarding American Board of Internal Medicine MOC program, the authors concluded that ''although nonrandomized data show an association between initial board certification and improved performance, there is little or no data showing improved outcomes of care related to recertification.''[22] Overall, the limited data did not show substantially better outcomes in care quality with board recertification. Further studies to quantify the relationship between board recertification and quality of physician practice are much needed.

Consideration: The IOMSC may share OEM training and certification examples for interested member OEM societies.

Limitations

Because not all OEM societies are members of the IOMSC, this survey is an incomplete global representation of OEM societies. The sample is skewed toward countries developed enough to have OEM specialty societies, mostly higher income countries. The missing data from countries not included in the survey may reflect a different state in the development of OEM training and expertise. The results of this survey were based on expert opinions, which may not necessarily represent the current OEM climate in the country. Because the survey did not collect any individual identifiable information, the research team could not verify if the participant was an OEM society leader in each country. IOMSC leadership mitigated this risk by sending the survey link only to confirmed OEM society leaders, with instructions to delegate completion to an officer in the society. The first question in the survey requires the participant to answer: ''Are you a current or former leader in a national or regional Occupational

Medicine specialty organization?'' If the answer was no, the follow-up question asked him/her to explain their connection to the OEM specialty organization.

Other limitations were unanswered questions or inaccurate answers. The questions were tested and refined based on feedback from occupational medicine residents, ACOEM staff, and IOMSC leadership. Despite those efforts, participants may answer questions differently due to personal interpretations of the questions. There is also the possibility that some words may have been lost in translation due to culture or language because the survey was provided in English to individuals for whom English may be a second language. Most countries were represented by a single response from a society leader. Apart from reaching out to four country society leaders to verify inclusion of OEM topics in the medical school core curriculum, the research team did not attempt to validate the accuracy of the responses. An answer could potentially be misleading, if, for example, the responding leader was far removed from medical education and was answering related questions based on remote personal experience. To minimize this risk, the survey asked the respondent to only answer the questions if they are familiar with current medical school curriculum. Lastly, because of the complex variations in OEM training and certification among different countries, the questionnaire contained some open-ended questions, which cannot be quantified, but which provide rich descriptive information for IOMSC leadership to review.

CONCLUSION

''The sphere of influence of OEM impacts millions of workers worldwide, with one OEM physician capable of impacting tens of thousands of employees and their families annually.''[23] OEM education, training and certification are critical in sustaining the OEM physician workforce globally. The COVID-19 pandemic poses both challenges and opportunities in the field of OEM. The crisis highlighted the OEM physician's essential role in public health, workforce health and safety, and risk mitigation strategies. This is a critical time in amplifying the development of OEM at the global level. Based on the high survey completion rate, IOMSC society leaders appear eager to work together and to improve the profession internationally. The IOMSC can further facilitate society collaboration to create a strong case demonstrating the value of OEM to employers, worker populations, the community, and governments around the world.[23] This survey identified several best practices and areas for growth. Continued advocacy for the value of OEM expertise in workers' health and productivity, in conjunction with international OEM partnership will provide the power for positive change in the future of OEM.

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