

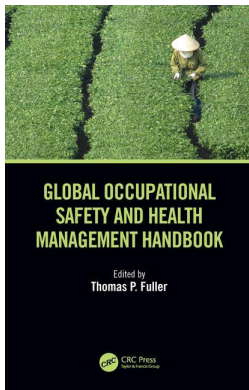
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9 Introduction to Global Occupational Safety and Health Education and Training

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9.1 INTRODUCTION

Millions of people are injured and killed each year while they are working. Many of these injuries and deaths are due to inadequate training or education in occupational safety and health (OSH). As technology becomes more sophisticated, associated hazards become more complex. Educating and training workers, employers, and even governments on hazards and the effective means to control and minimize them is becoming increasingly challenging. As hazardous industries move to and grow in economically developing countries (EDCs), the need for training and education is ever more urgent. Although developed countries have existing education

and training systems, improving international harmonization and inter-coordination might lead to consistent curricula to be used globally. Some international training organizations have arisen to provide educational materials and courses in developing nations. Growth of these programs, and the possible use of online courses, may be a way to provide sufficient numbers of educated and qualified OSH workers, managers, and professionals moving into the future.

OSH professionals use education and experience to anticipate, recognize, evaluate, and control workplace risks. Their goal is to provide workplaces free from hazards that can cause injury, disease, or death. They work to prevent exposure to conditions and agents identified and treated by occupational health nurses and occupational medicine physicians. OSH professionals bring expertise in engineering, ergonomics, toxicology, chemistry, and statistics to help prevent diseases and injuries before they occur.

In the past, OSH professionals received training in one of the core sciences and then morphed into their safety roles through experience or additional coursework. In recent years, however, with the expansion of knowledge and sophistication in safety science and industrial hygiene, entire baccalaureate undergraduate programs have become warranted. In addition, advanced graduate degrees have become commonplace. Graduates of doctoral programs in the safety sciences and industrial hygiene have the ability to analyze hazards and develop highly advanced and innovative controls, even as technology advances at a rapid pace on many other fronts.

Unfortunately, the ever-increasing demands for OSH professionals are significantly outpacing the ability of existing educational infrastructure to supply competent and qualified graduates. Workers in developing countries with expanding economies are still subject to ever-increasing OSH risks. The least developed countries are falling further and further behind (Ahasan, 2001). In addition, the governments and organizations in economically challenged countries are often comparatively unaware of the risks of human exposure to toxic industrial agents and industrial operations. In some developing countries, only 10% of workforce activities are covered by any form of regulation or governmental protections for worker safety (LaDou, 2003).

The majority of the world's workers do not meet the minimum safety standards outlined by the International Labor Organization (ILO) or the World Health Organization (WHO) (Goldstein, 2001). Much of the problem is the lack of professionals educated or trained on the basic fundamentals and principles of OSH (Lucchini, 2014). Many of these shortcomings are associated with the lack of qualified and trained professionals either in the government or in the industry (Parikh, 2003). Even in economically advanced countries, there remain a shortage of qualified and competent OSH professionals, particularly in small to mid-sized enterprises, and for specialty topics.

The costs in terms of human injury, suffering, and death are staggering. Approximately 2.3 million people die from work-related accidents or diseases each year, or about 6,300 workers each day (ILO, 2017). And millions of workers are injured on the job each day around the world. The global economic burden of workplace accidents and disease-related illnesses is estimated at 4% of global gross domestic product each year (ILO, 2017). If it is assumed that many of these injuries, illnesses, and fatalities could be prevented through effective controls, then

more trained professionals are needed to analyze workplace hazards and provide protection.

There is a need to determine where the OSH educational shortfalls are most prominent, and how a greater number of well-trained OSH professionals can be added to the occupational health team supply. This chapter attempts to analyze and explain the existing capabilities for OSH education in individual nations and regions. Then, in the next portion of the chapter, currently available global OSH training programs will be described. Finally, existing systems and shortcomings will be analyzed in an attempt to identify some possible solutions to the shortages, and to identify some possible future directions for human resources capacity building in OSH.

9.2 WORKER TRAINING

In recent years, businesses and organizations have expanded operations and supply chains broadly into other countries and regions of the world. Free markets have become less centralized and consumer access to information has brought increased demand for products and materials from distant parts of the globe. Suppliers need to supply the demands of the consumers and expand their product lines in order to remain competitive (Gerhardsson, 1998).

As global markets expand, employers also feel a need to hire and retain the best and most educated and experienced workers. Globally accepted standards of practice for OSH and protection of the environment have been developed that include a minimum criterion for OSH professionals (ISO, 2018; EU, 2002; BSI, 2007). Human resource managers need to be able to find good workers in any area of the world. Employers need to ensure that their workers are continuously trained and updated on the latest methods and techniques just to stay competitive. Workers in global organizations need to have comparable skills across multinational satellite locations. Employers working in or moving to a developing country need to either bring a competent experienced workforce with them when moving to a new geographic region, or hire and train a workforce locally in the new region. Often, a combination of transported and regional workers is used to fulfill all employee quotas for a given project. New workers hired regionally must be trained by the new employer, and as a result, they become more valuable as workers, and demand for them will increase over time.

Multinational organizations and corporations need to identify their human resource needs and then determine how they will fulfill them in the international locations. The levels and types of workers may be stratified locally, regionally, and internationally. Some OSH capabilities may be required at a local level at all sites. Other OSH capabilities and activities may be provided from a central location with periodic worker travel to regional or international sites. Various internal or external sources of training need to be identified to structure and supplement the global workforce.

Studies have shown that highly educated and skilled professionals are often not motivated to seek out all the latest resources available to them, but rather tend to rely on their initial training and past work experiences to make decisions (Schaafsma, 2004). One study of occupational health physicians demonstrated that doctors did

not make significant efforts to seek out the latest scientific information regarding treatments and diagnoses of occupational injuries and diseases (Hugenholtz, 2007). Although there are likely exceptions in every case, the tendency to rely on training and experience, and not seek new ways of doing work, is probably generally true for other sorts of professions, including OSH. Educational or certification credentials that require ongoing professional development and training is one method to ensure professionals remain current in their fields.

Even skilled and experienced OSH professionals with access to high-level sources of information need to be shown where the material is, and how to access it and put it to use. Sources of timely information can include online peer-reviewed journal articles, access to library systems, and publications available through the government, tripartite groups, labor representatives, and professional organizations. Websites and webinars can also be a valuable source of timely information. Professionals may need training on the latest topics and issues in OSH and direction on where to access the current standards of practice on a variety of topics.

9.3 OSH WORK ABROAD

The need for OSH educated and experienced professionals has continued to expand globally. But not all of these professionals have the experience, inclination, or soft skills necessary to succeed on international assignments. OSH professionals need additional credentials in order to be effective working abroad. Experience in working and traveling internationally provides some insight into the aptitude of a potential international candidate. These workers need to be sympathetic to other cultures and regulatory systems. The ability to speak the language of the foreign assignment is often a prerequisite. Specialized consulting firms have begun to provide cultural education services prior to and during international assignments to prepare employees and their families for extended assignments abroad.

Personal characteristics and cultural backgrounds of expatriates have been shown to be closely tied with an individual's success and willingness to work in exotic cultures and geographic locations. A person's willingness to travel physically and psychologically is imperative to success on the job when working abroad (Sullivan, 2006; Forrier, 2009).

Companies with continuing global operations need to include experience and other success factors when considering hiring or career advancement of new and existing workers. Prior international assignments are important determinants in the future success in foreign assignments (Jokinen, 2010). In general, employees with international experience tend to have higher individual career competencies and are more effective working in organizations. Global leadership skills improve from boundary spanning activities such as rotational assignments and directed training on global management issues (Mendenhall, 2012).

Foreign language skills play a key role in the success of professionals working internationally (Itani, 2015). The ability to speak a foreign language differentiates workers from other staff and makes them more successful in international assignments. Speaking the language of the country where they are working allows employees to better understand local regulations, cultural norms, and organizational

policies or programs. Workers who speak the local language build better workplace relationships and assimilate more easily into the local culture (Itani, 2015).

Companies that are successful in their global business strategies will be those that have strong international OSH programs and staff experienced in global operations (Nunez, 2011). Competent and qualified OSH staff will continue to be in increasing demand; companies with a steady supply of global OSH workers will have a competitive advantage over other organizations (Nunez, 2011). As workplace technologies and operations become more complex and hazardous, the availability of a competent OSH staff that can adequately address the risks becomes even more important.

As operations of an organization expand globally, there is an increased need for effective coordination of OSH programs, policies, and practices. Management systems need to include the means for standardization of OSH practices, when necessary, and communication of program requirements. When local norms, regulations, or environmental factors require changes to OSH practices, the programs need to consider these and be altered accordingly. Existing international management standards such as ISO 45001 can be used to help structure such international OSH programs. The same OSH program activities essential in homeland operations must be considered in international operations. This includes risk assessment, hazard control, training, and change management (Nunez, 2011). The collection, analysis, and interpretation of OSH data that are important in national operations will be equally important, yet more difficult to obtain and manage, in international activities.

CASE

A large multinational paint manufacturer recently opened a facility in Malaysia. One of the job tasks performed outdoors required workers to wear rubber coveralls, a rubber hood, full-face respirator, and heavy rubber boots and gloves for about 45 minutes in order to protect themselves from the dust coming from a hopper when it was filled with a plasticizer in power form. When this activity was performed in Michigan, US, outdoor temperatures were seldom over 24 degrees Celsius, so heat exhaustion or strain was not typically an issue. In Malaysia however, it was not uncommon for temperatures to exceed 30 degrees Celsius much of the year. In addition, the relative humidity in Malaysia is often 70 or 80 percent in certain seasons.

How would the risks to the workers performing these tasks change between the two countries? What types of controls might the international organization incorporate to better protect the workers in Malaysia for the risks that you listed? What are some cultural or regional factors or concerns that you might consider in your answers?

9.4 EXISTING GLOBAL OSH TRAINING MODELS

Existing training programs cannot provide the number of health and safety professionals needed to address increasingly sophisticated technologies and associated OSH hazards globally. The need for professionals trained and qualified to recognize, evaluate, control, and mitigate hazards continues to increase (Kromhout, 2002). Additional training is needed at both the technical and professional levels, in both developed and developing countries. In an attempt to fill the void, a variety of international training models and organizations have arisen.

Professional training in OSH is to be encouraged through continuous learning by participation in various professional organizations offering training through conferences, technical courses, and webinars. Students and professionals with limited resources are encouraged to attend conferences abroad when possible or if not, attend webinars online to expand knowledge or awareness. Economically disadvantaged potential students should always ask for a discount as many organizations will reduce the course rates when need is demonstrated. Operators of these courses should also be sure to market these materials to economically challenged regions and potential students by stating that discounts or various scholarships may be available.

9.4.1 OCCUPATIONAL HYGIENE TRAINING ASSOCIATION

The Occupational Hygiene Training Association (OHTA) promotes occupational hygiene standards of practice on an international platform. OHTA develops a variety of educational training materials, including texts, slide presentations, work exercises, and assessment tools. These materials are made available online at the OHTA website and are available for training providers, students, and the general public for free. The organization is the result of collaborations between several international groups and depends on the support of occupational hygiene professional volunteers for a significant amount of the work that is completed (OHTA, 2018).

OHTA is a registered charity in the United Kingdom. Operating costs are kept to a minimum through the use of volunteers and are funded by small fees on approved training providers and OHTA examination fees. Sponsors and supporters also provide funding and support various OHTA projects, such as new course development and translations of course materials to other languages.

Many OHTA courses are taught around the world in EDCs by volunteer occupational hygienists as a way to build capacity in countries and regions with shortages of OSH professionals. Many of these areas such as Botswana, Swaziland, Vietnam, Mozambique, and Tanzania have little OSH capacity and little educational development in the subject. OHTA materials in collaboration with other support organizations, such as the International Occupational Hygiene Association (IOHA) and Workplace Health Without Borders (WHWB), go a long way in improving the capacity of OSH and ensuring the health and safety of workers in these regions.

OHTA courses are also offered by training consultants for fees, and used by multinational corporations to train staff globally. The materials represent the latest methodologies and standards of practice in occupational hygiene and are an excellent training resource for any organization. Approved training providers are listed on the OHTA website.

OHTA modules can be used as stepping stones to professional certification by organizations within the IOHA National Accreditation Recognition program. Completion of six intermediate OHTA modules earns an International Certificate in Occupational Hygiene (ICertOH). The ICertOH in addition to a bachelor's degree in subject area topics (e.g., chemistry, engineering, and biology) and work experience can qualify a candidate for NAR examination and certification.

Current OHTA courses offered include the following

- W201 Basic Principles in Occupational Hygiene
- W501 Measurement of Hazardous Substances
- W502 Thermal Environment
- W503 Noise—Measurement and Its Effects
- W504 Asbestos and Other Fibers
- W505 Control of Hazardous Substances
- W506 Ergonomics Essentials
- W507 Health Effects of Hazardous Substances

9.4.2 WORKPLACE HEALTH WITHOUT BORDERS

WHWB is a nongovernmental nonprofit organization founded in 2011, with a volunteer workforce that conducts various training courses globally. The goal of WHWB is to engage volunteers with expertise in exposure and risk assessment, hazard control, and other technical areas of occupational hygiene to donate time to support projects in underserved worker populations around the world. The focus of the organization is on research, infrastructure development, and training to improve worker health in low-income and low-opportunity countries and regions (WHWB, 2018). WHWB members volunteer their time and often teach week-long OHTA technical courses in EDCs. The host country organization provides a course venue, markets the course to local OH professionals, and collects a nominal fee for course attendees, typically up to 30–35 students. The airfare and ground food and accommodations for the trainer are paid by the host from the course proceeds, and the host still typically makes a profit that may support the host organization or local professional societies. WHWB has already provided OHTA and other courses in Mozambique, Tanzania, Vietnam, South Africa, Botswana, and Swaziland. A recent OHTA training course conducted by WHWB in Swaziland is shown in Figure 9.1.



FIGURE 9.1 An OHTA course being taught by WHWB in Swaziland. (Photograph courtesy of Thomas P. Fuller.)

9.4.3 INTERNATIONAL OCCUPATIONAL HYGIENE ASSOCIATION

The IOHA is a nongovernmental and not-for-profit global community of occupational hygienists and professionals who are dedicated to the discipline and application of the inherent principles used to protect workers from hazards to reduce injury and illness (IOHA, 2018). Activities include the development of comprehensive health and safety training materials and holding international conferences to support the exchange of information and ideas. With more than 13,000 chartered safety and health practitioners, IOHA has more certified professionals than any other organization (IOHA, 2018).

9.4.4 INTERNATIONAL TRAINING CENTER OF THE ILO

The International Training Center of the ILO (ITCILO), located in Turin, Italy, provides a variety of courses as a means to improve human resource capacity and capabilities in a broad range of areas, including OSH. In March 2017, the International Training Center (ITC) conducted a 10-day course on inspection of OSH onsite for 3,600 euros, including accommodations. Also in 2017, the ITC conducted a distance learning online course on OSH in eight modules covering a variety of topics. The course tuition costs 3,000 euros (ITCILO, 2017).

9.4.5 INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH

The Institute of Occupational Safety and Health (IOSH) is an organization of safety and health professionals working together to try and improve worker health internationally. This group provides fundamental courses in safety management at various locations and times throughout the year. IOSH provides guidelines of ethical conduct for practicing safety professionals and a basic credentialing scheme based on attendance and graduation from specific academic institutions in the United Kingdom and other universities approved by the organization (IOSH, 2017).

9.4.6 WORLD HEALTH ORGANIZATION

The WHO has a variety of projects and publications on occupational health and safety on a broad range of topics. (WHO, 2013) They also conduct seminars and conferences to discuss current issues and future directions. In the 2007 Plan of Action for the WHO (2007), they identified training of workers and employers on occupational health as a priority (WHO, 2007). The WHO website has a variety of training modules in several languages available to the public for free.

9.4.7 EUROPEAN NETWORK EDUCATION AND TRAINING IN OCCUPATIONAL SAFETY AND HEALTH

The European Network Education and Training in Occupational Safety and Health (ENETOSH) is a network of more than 80 partners in 33 different countries. The goal of ENETOSH is to mainstream OSH into all levels of education and training

as a means to develop a culture of OSH injury and illness prevention in society. The network is coordinated by the German Social Accident Insurance (DGUV) Institute for Work and Health (IAG). The organization is governed by a steering committee comprising representatives from network members.

In order to affect all social levels, ENETOSH believes that a lifelong learning approach is integral to effective and lasting OSH education and training. ENETOSH programs cover all areas of education from kindergarten, primary school, secondary school, colleges, universities, and continuing vocational training. Courses and projects result from collaborations between professionals with expertise in all aspects of OSH and education. Target groups for courses include educational, insurance, policy makers, governments, nongovernmental, and tripartite organizations globally.

One of the current ENETOSH projects is the systematic collection and dissemination of good practice for OSH education at all levels. The quality management system for the project includes a list of criteria for selecting examples of good practice, a data collection system, a coding system, program statutes, and a code of practice of users of the ENETOSH platform. Selected examples of “good practice” are available on the ENETOSH website where users can perform searches for certain keywords and selection criteria. The website includes examples of how to mainstream OSH training into course content and curricula at all educational levels.

Another ongoing ENETOSH project is the development of a consensus standard of competence for teachers in OSH. This project focuses on the improvement of competencies of teachers, lecturers, and trainers.

ENETOSH is an open network, and all experts dealing with OSH and education or training are welcome to join. Some of the existing network organizations are shown in the following list:

- European Center for the Development of Vocational Training (CEDEFOP)
- European Map of Intergenerational Learning
- European Network for Workplace Health Promotion (ENWHP)
- European Network of Safety and Health Professional Organisations (ENSHPO)
- The International Network of Safety & Health Practitioner Organisations (INSHPO)
- World Health Organization Global Network Collaborating Centres for Occupational Health

9.5 FORMAL OSH EDUCATIONAL SYSTEMS

OSH educational approaches vary greatly between countries. The profession of occupational hygiene is perhaps most similar between the United Kingdom, Australia, and the United States; however, even in these countries, the training of OSH students is quite different. In Australia, occupational hygiene is taught at the master’s level at three universities, and the doctorate is offered at one. In Great Britain, occupational hygiene is also taught at the master’s level. In the United States, however, several universities offer bachelor’s degree in occupational hygiene, in addition to master’s and doctoral degrees. In the United States, the American Board of Engineering Technology (ABET) accredits university programs in a broad variety of areas including occupational

health, environmental health, safety, and occupational hygiene. This accreditation is a measure of program effectiveness and other categories (ABET, 2018).

In the United States, the first environmental health program was established in 1913 at the Harvard—Massachusetts Institute of Technology School for Health Officers. Many of the initial advances in occupational hygiene stemmed from the research conducted in these universities including development of ventilation and engineering principles in the protection of workers from airborne hazards, and the advanced understanding of the importance of the respiratory tract as the route of absorption for toxic aerosols. For over a century, the Harvard Department of Industrial Hygiene and other associated divisions such as Environmental Health and Engineering Sciences have continued to make advances in research and education in occupational hygiene, safety, industrial medicine, and other related subjects (Harvard, 2018).

The National Institute of Occupational Safety and Health (NIOSH) has created a program of Educational Research Centers (ERCs) with the goal of providing training and educational programs to build capacity in OSH. The ERCs focus on technological advances, globalization, and new and emerging risks to prepare workers and graduates of ERC programs. The training and associated research are conducted at 18 official ERC sites and numerous other affiliated universities and organizations. The existing NIOSH ERCs are listed in Table 9.1.

European educational approaches to OSH vary considerably by country. Academic programs in OSH in Europe began in the 1970s. These programs did not grow significantly; however, until around the 1980s or 1990s when there was an increased awareness of the value of OSH after several significant industrial accidents in Europe, these programs demonstrated the need for a better understanding of risk

TABLE 9.1
NIOSH Educational Research Centers

University of Alabama at Birmingham
University of California, Berkeley
University of California, Los Angeles
University of Cincinnati
University of Colorado Denver
Harvard T.H. Chan School of Public Health
University of Illinois at Chicago
University of Iowa
Johns Hopkins Bloomberg School of Public Health
University of Kentucky
University of Michigan
University of Minnesota
Mount Sinai School of Medicine
University of North Carolina at Chapel Hill
University of South Florida
University of Texas Health Science Center at Houston
University of Utah
University of Washington

assessment and hazard control. In general, European occupational hygiene programs are less structured than those in the United States. Rather than taught as a discreet field of inquiry, universities in Europe tend to teach OSH in a fragmented manner where various other technological, managerial, and scientific fields such as engineering and medicine curricula include coursework in OSH (Hale, 1997). Students in master's programs generally enter with bachelor's degrees in other relevant sciences such as chemistry, engineering, or physics. In a study of postgraduate courses in OSH in 18 European countries, courses in OSH have been increasing consistently over the past decade. Programs include courses in safety science, occupational health, risk assessment, management, prevention, and environmental science. Programs are typically run under engineering, applied science, or management departments. But despite continuing attempts to harmonize educational curricula and outcomes, OSH programs, course structures, and course content continue to vary (Arezes, 2012).

European higher education of OSH includes a variety of methods. In the United Kingdom, OSH is integrated into risk education and engineering. In Portugal, OSH is integrated into engineering graduate and postgraduate programs. In Austria, safety prevention, emergency response, biological hazards, and radioactive materials are covered in laboratory safety courses. And in Spain, postgraduate courses are offered in the management of occupational risks (Reinhold, 2014). In France and the United Kingdom, safety and occupational hygiene courses occur at the master's levels as part of other sciences and are commonly aimed at risk assessment and reliability rather than industrial hygiene (Arezes, 2012). There are also master's and doctoral programs in ergonomics, human factors engineering, and OHS management.

In Germany, two main branches deliver OSH training. One branch is done by accident insurers and is closely affiliated with safety engineering. The second branch is offered to physicians and advanced training in occupational medicine and is provided by specialized colleges and universities. Unfortunately, at this time, harmonized training and standardized curricula for occupational hygiene are lacking in Germany. Most safety engineers arrive from the bachelor degree university level. The occupational hygiene profession and standards or practice are not well defined in Germany at this time.

In Belgium, occupational hygiene is one of the welfare domains as included in the Act on well-being of workers in the performance of their work (04/08/1996) and the Royal Decree on the policy of well-being of workers at work (27/03/1998). The Internal and External services for Prevention and Protection at work requires employers to have prevention officers and experts with various skills, including occupational hygiene. Occupational hygienists collaborate with other prevention officers in a multidisciplinary way.

There are two training courses in which the Belgian Society for Occupational Hygiene (BSOH) participates substantively. One program is a Dutch specialist training course for prevention officer occupational hygiene that is offered in collaboration with KU Leuven, Odisee, and BSOH. The Dutch course runs over two academic years and is mainly given at the KU Leuven Gasthuisberg campus. The second program offered is a French specialist training course for prevention officer occupational hygiene taught in collaboration with Universite Catholique de Louvain (UCL), Centre d'enseignement superior (CPFB), Ecole Polytechnique de Louvain, the European Confederation of Independent Trade Unions, and

BSOH. The French training course runs over two academic years and is taught at Louvain-la-Neuve-UCL.

The purpose of this training is to prepare students for the daily interpretation of a job as occupational hygienist, based on a thorough theoretical knowledge combined with practice-oriented applications. One learns to identify and assess chemical, physical, and biological hazards at the workplace. For the different topics, a similar course structure is followed, consisting of the following:

1. Organization, legislation, and limit values
2. Agents with specific hazard properties
3. Toxicology and routes of exposure
4. Health effects
5. Measurement possibilities: external and internal doses
6. Preventive measures

The training aims that at the end of the course, one has the required knowledge and skills to take necessary preventive measures in specific work situations, leading to better hygiene and health at work. This is done in consultation with a multidisciplinary team of prevention officers and safety experts (engineers, occupational physicians, ergonomists, psychologists, and environmentalists). This training is meant for all interested parties for prevention and well-being of workers in companies and organizations. The program is conducted in accordance with the prescribed requirements, as specified in the Royal Decree on the expertise of the prevention officers of the external services for prevention and protection at work (5/12/2003). Prevention officers that are experts in occupational hygiene are required to have successfully completed the specialization module “Occupational Hygiene.”

In order to meet the upcoming demand for OSH professionals, new and more educational programs need to be developed and provided in a more structured and formalized approach (Arezes, 2013). The growth of internationally standardized models for occupational hygiene training and curricula will help guide the future development of education systems in Europe and other regions of the world. International recognition of OSH education credentials and other professional certifications, like that of IOHA, that require specified training in OSH will also help push the future development of the occupational hygiene training models. As the expectations of governments and global employers become more sophisticated and harmonized in what is expected in OSH staff, educational approaches will need to advance to satisfy the demand.

9.6 OCCUPATIONAL SAFETY AND HEALTH EDUCATIONAL CURRICULA

In a study of potential employers, the capabilities shown to be most important in recent OSH graduates included the following:

- Hazard identification and control
- Understanding relationships between exposures and health outcomes
- Interpretation of laws and regulations

- Ability to describe physical, chemical, and biological aspects of hazards
- Collecting, managing, and analyzing data
- Interpreting and applying scientific findings
- Exposure assessment and risk characterization

In addition, employers preferred to have graduates who have learned how to work in teams, speak publicly to conduct training and make presentations, and communicate effectively in writing (Brosseau, 2009). It is also important for new OSH graduates to have decision-making, personal, management, and social skills in order to be successful professionals.

As OSH professionals gain education and experience, they reach a level where certification by a respected credentialing body is a way to demonstrate expertise in their respective profession (Adams, 2004). The most reputable credentials are those that require graduation from an approved academic program, a minimum number of years of practical work experience in OSH, and passing a comprehensive and rigorous certification examination. In an effort to standardize the credentialing bodies operating around the world, the IOHA has created an evaluation rubric to identify the various comparable OSH certifications internationally. The rubric includes detailed information regarding educational level and course content for related accepted university degrees. The following list represents the credentials currently seen as comparable by IOHA:

- American Board of Industrial Hygiene (ABIH)
- Australian Institute of Occupational Hygienists (AIOH)
- British Occupational Hygiene Society (BOHS)
- Canadian Registration Board of Occupational Hygienists (CRBOH)
- Dutch Occupational Hygiene Society—NVVA
- French Occupational Hygienists Society (SOFHYT) (Document in French and English)
- German Society for Occupational Hygiene (DGAH)
- Hong Kong Institute of Occupational and Environmental Hygiene
- Institute of the Certification of the Figures of Prevention (Italy) (ICFP)
- Japan Association For Working Environment Measurement (JAWE)
- Malaysian Industrial Hygiene Association (MIHA)
- Norwegian Occupational Hygiene Association (NYF)
- Swedish Occupational and Environmental Certification Board (SOECB)
- Southern African Institute for Occupational Hygiene (SAIOH)
- Swiss Society of Occupational Hygiene (SSOH)

9.7 EXISTING LIMITATIONS AND FUTURE DIRECTIONS IN GLOBAL OSH EDUCATION

As technology advances, occupational hazards evolve and become more complex. To some extent, this has led to further compartmentalization of OSH practice. Occupational health physicians (doctors who prevent and treat diseases and injuries that occur in the workplace) who play a significant role in many national OSH regulatory systems, and may have in the past been more involved in workplace assessments,

now must spend too much time keeping up with expansion and advances in medicine, such as toxicological consequences of exposure to new chemicals or materials such as nanoparticles, to spend time in the field in physical workplaces. As a result, and in addition, industrial hygienists, ergonomists, and general OSH professionals must now increase their capacities for anticipation, evaluation, and control of hazards in numerous new and old industries.

Due to the growth of industry around the world and particularly in EDCs, formal educational institutions cannot keep up with the need for OSH professionals or qualified graduates from OSH programs. In addition, there is a significant amount of global variability in OSH curricula between academic institutions and credentialing.

Initiatives to provide training at the worker level are even more disparate. Although a large amount of training materials are available on a broad range of topics from such reputable and prestigious agencies such as the WHO and ILO, there is no clear direction or pathway for workers, employers, or governments to follow towards human resource development and ultimately credentialing and certification of OSH workers internationally. Perhaps the closest system is that provided by the OHTA where students take an examination after their courses and receive a certificate of recognition for each course, and a series of course certificates can lead to another level of recognition. Educational certificate programs such as these have been shown to be one of the best ways to develop OSH capacity in an existing workforce (Rosen, 2014). Other than university degrees, the OHTA system seems to be one of the only international programs that include examinations and such certificates along with their courses.

Although many of the ILO and WHO documents are available in multiple languages, most other training materials available online are generally only in English, or sometimes Spanish or French. Perhaps a weakness of this study and analysis is that little research can be conducted in China, Russia, and India without working knowledge of those languages. But this is also a weakness in getting information on western advances in OSH to those countries.

Moving forward, it seems that an optimal area for the advancement of modern OSH principles globally will be through the use of the Internet for training (Van Dijk, 2015). As training tools become more advanced and easier to use, it may be possible for students in Africa to not only access OHTA training modules and materials, but actually take courses and earn certificates online. It seems a logical next step for the advancement of worker capabilities and rights.

There is a great need for further development of OSH programs of study and the harmonization of curricula so as to increase the numbers of competent professionals, and ensure that competencies are more comparable and interchangeable between countries. These improvements could be used for models of expansion globally, to improve the numbers and quality of OSH professionals in expanded regions.

A bit of variety in college curricula and credentialing rubrics will be inevitable moving forward. Each country has different cultures, capabilities, and workplace settings. But hopefully communication between tripartite, professional, educational, and labor organizations will improve, and they will work towards

a consensus to clarify the OSH professional role in worker health and safety, and educational requirements. This would go a long way in helping workers and organizations in EDCs continue to improve their understanding and capabilities in OSH.

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