On Linkages

THE WHO MODULES IN OCCUPATIONAL SAFETY AND HEALTH: TRAINING FOR PREVENTION

Linda Forst, MD, MPH
Leslie Nickels, MEd
Lorraine Conroy, ScD

More than 2.9 billion adult and child workers throughout the world are exposed to mechanical, chemical, biological, physical, and psychosocial hazards.[1] According to projects by the World Health Organization (WHO) and the International Labour Organization (ILO) on the global burden of occupational injuries and diseases, these workers suffer an estimated 140,000 to 355,000 occupational injury deaths per year.[2–5] Estimates of occupational diseases range from 325,000 to 1.6 million.[4–7] These numbers are influenced, in part, by the degree of economic development and the status of policies and services designed to protect working populations.

The WHO estimates that only 20% to 50% of workers in industrial countries, and fewer than 10% of workers in developing countries, have access to occupational health services.[8] The ILO lists the following 11 functions as being integral to occupational health services: (*1*) identifying and assessing risk, (*2*) surveilling workplace hazards, (*3*) designing safe workplaces, (*4*) developing programs for improved work practices and for evaluating new equipment, (*5*) advising on occupational health, safety, and hygiene, (*6*) surveilling workers' health, (*7*) promoting adaptation of work to the worker, (*8*) managing vocational rehabilitation, (*9*) organizing training and education, (*10*) organizing first aid and emergency treatment, and (*11*) analyzing adverse conditions that lead to injury and illness.[9] The ability to provide these services depends on the will of governments and businesses, as well as the availability of personnel with the expertise to perform these functions.

Providers of occupational health services include occupational hygienists, safety specialists, occupational physicians, nurses, toxicologists, ergonomists, and epidemiologists. Needs assessments contracted by the ILO, WHO, and academic and nongovernmental organizations (NGOs) have demonstrated a lack of occupational health professionals in most of the developing and much of the industrialized world.[10,11] Schemes for training professionals in the U.S. have led to the education and certification of 76,000 professionals—far less than the number considered necessary, especially for certain sectors of the economy.[12] Similar studies in developing countries have demonstrated an almost complete absence of trained professionals. Ironically, those countries with the most hazardous jobs and the most vulnerable populations tend to have the least number of experts. Needs assessments in Sub-Saharan Africa,[13] Northern Africa,[14] Central America (Unpublished data, Aragon A, Torres C, Guevara R, Blanco L. Perfil Nacional sobre Salud y Seguridad en el Trabajo en Nicaragua. Report to the ILO, 2004), South America,[15] Southeast Asia,[16,17] and South Asia,[18] as well as international reviews[19] have described a dearth of expertise and training among professionals who have the opportunity to affect health protection in the workplace.

THE WHO OCCUPATIONAL HEALTH MODULES

The WHO Programme in Occupational Health contracted the University of Illinois at Chicago School of Public Health to develop a state-of-the-art educational program in occupational health, hygiene, and safety for professionals—physicians, nurses, labor inspectors, health ministers, and worker advocates—that would:

1. Cover the content of occupational health practice (health, hygiene, safety).
2. Be relevant to practitioners worldwide.
3. Impart basic knowledge and principles through practical skills building.

Articles for *From the Schools of Public Health* highlight practice- and academic-based activities at the schools. To submit an article, faculty should send a short abstract (50–100 words) via e-mail to Allison Foster, ASPH Deputy Executive Director, at afoster@asph.org.

4. Be used with multidisciplinary audiences to foster appreciation for collaborative work across disciplines.
5. Be flexible, allowing for use by different instructors in different settings.
6. Be adaptable to needs in different countries.
7. Be evaluated for effectiveness according to the participants and the host countries.
8. Be easily disseminated.

Program development

Consideration of course content, design of materials, mode of delivery, and dissemination capabilities are integral factors in developing a successful program. Evaluation of efficacy and effectiveness are essential components for translating this workplace illness and injury prevention program into practice. Layered on top of the basic criteria for course development, there was a need to develop a broad program that could be used for audiences with different educational backgrounds and different purposes for taking the class. The content and activities would have to be flexible enough to be useful in different countries and in different work and community settings. This required a multidisciplinary and multinational team to develop and evaluate the program.

Course content

The aim of the course is to provide a basic but comprehensive introduction to hazards in the workplace and how to control them. It was designed according to the following principles: (*1*) workers are entitled to a healthy and safe work environment, (*2*) identification and characterization of hazards requires a systematic approach and is essential for preventing work-related illnesses and injuries, (*3*) injuries and illnesses are sentinel health events that denote a failure of preventive measures and warrant investigation, and (*4*) knowledge of hazardous working conditions should trigger investigations, without the need for sentinel health events.

Three modules were developed by an occupational hygienist, an occupational physician, and an education specialist with extensive experience in occupational health; training and education experts in medicine and hygiene also contributed. The scope was restricted by available funding from the WHO and by the deadline for completing the work. A schematic diagram and annotation were developed to describe the way in which occupational health, hygiene, and safety should be approached in the workplace and to frame the course's content and flow of delivery (Figure 1). A list of objectives, topics, and potential student activities was generated, and we decided to use case studies framed by economic sectors; cases came from Mexico, India, and the U.S.

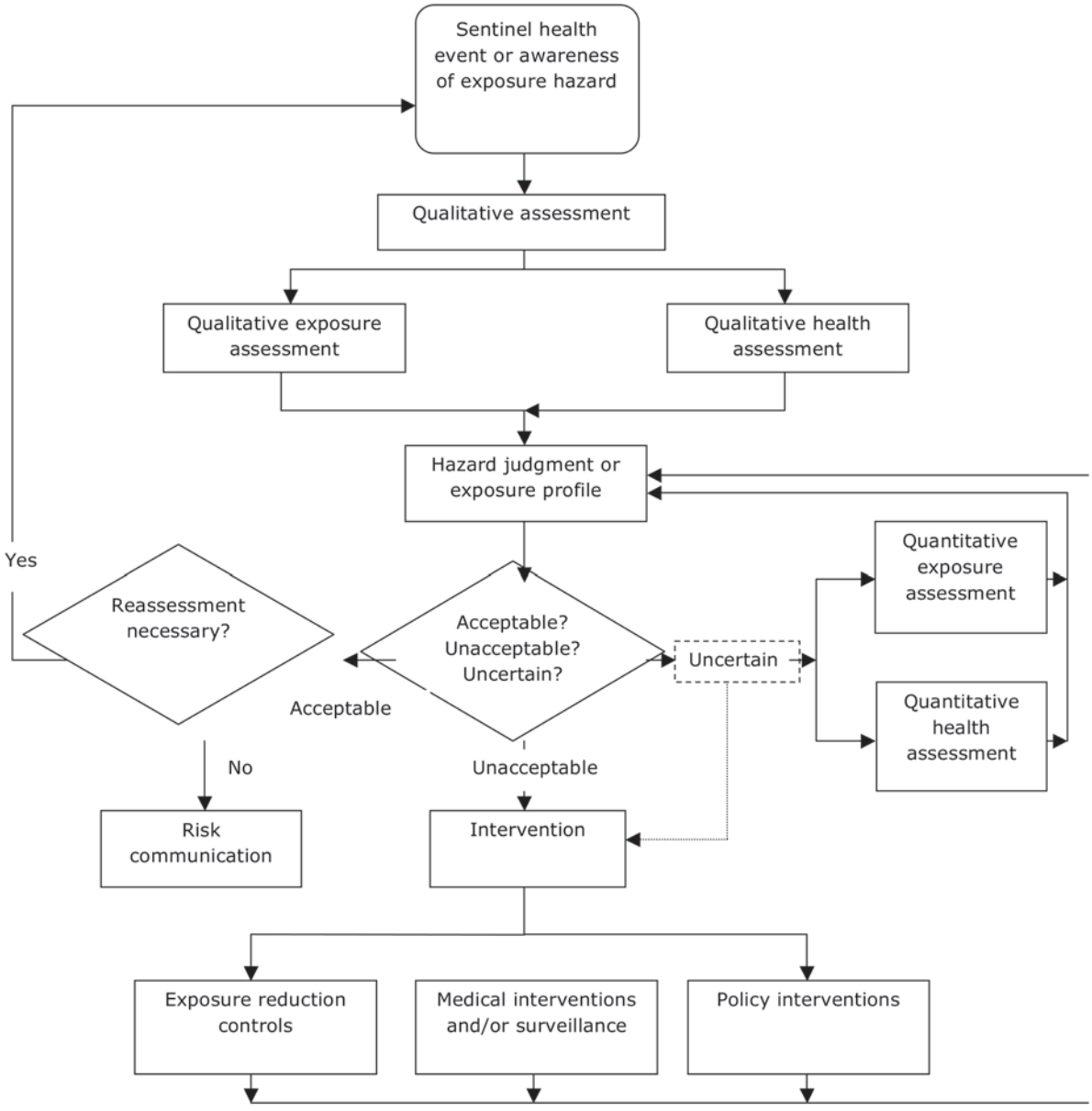
Because agriculture employs more than 70% of people in developing countries, pesticide poisoning in agriculture was selected as the basis for the first module. A pesticide poisoning case came out of a project conducted in a small agricultural community in Mexico. The manufacturing sector module contains a case study from India on an injury in a tannery and was adapted from a study of the tanning industry conducted by the Indian National Institute for Occupational Health. The service sector module case study is about a needle-stick injury in a nurse, adapted from a U.S. study.

Design of materials

The course is divided by economic sector into three 16-hour modules (Figure 2). All modules contain a mixture of student activities related to the conceptual model: a sentinel health or exposure event, qualitative and quantitative exposure assessment, hazard judgment, intervention, and risk communication. Figure 3 describes the content, student activity, and work product of every part of the course. Each module consists of an instructor's manual with instruction for use, learning objectives, resources required, an answer key for all discussions, and tools for use in the class (e.g., slideshows, readings, policy documents, and forms to be completed by students). There are suggestions for swapping readings and other content from local sources, depending on the audience and setting.

The curriculum is designed for professionals who are concerned with the prevention of workplace illnesses and injuries, including health-care providers, public health workers, union representatives, labor inspectors, environmental health officers, managers in ministries of labor and health, and others. It is envisioned that each module could be used exactly as designed for a multidisciplinary audience from disparate worksites. The modules could also be rearranged for specific audiences. For example, occupational health and safety personnel from a single enterprise or a single economic sector could extract exercises and activities that are pertinent to those workplaces. They could take a case or circumstance from their own workplace and apply the course exercises to solve problems; they could select the hygiene or policy-oriented activities; or they could select readings or policy documents from their specific industry—using the slideshows and activities as principles—and apply them to concerns other than the cases presented in the modules. Instructors are invited to alter slideshows (i.e., add local digital

Figure 1. Framework for design of the World Health Organization Modules in Occupational Health



photos), introduce journal articles conducted in their home country, develop workplace walk-throughs for settings other than a health-care facility, or make the walk-through checklist more pertinent to local conditions. Although an interactive, hands-on experience is envisioned, instructors could try different pedagogical techniques to reinforce learning, such as lectures, textbook readings, or student presentations.

Figure 2. Economic sectors, workplaces, and hazards framing the teaching cases used in the World Health Organization Modules in Occupational Health

Economic sector	*Workplace*	*Hazard*
Agriculture	Crop farm	Pesticides
Manufacturing	Tannery	Chemicals, trauma
Service	Hospital/clinic	Bloodborne pathogens

Figure 3. Description of content topics, activities, and products of the courses comprising the World Health Organization Modules in Occupational Health

Content topic	*Activity*	*Student work product*
Module: Service sector		
1. Sentinel health/exposure events		
a. Who is a health-care worker (HCW)?	Guided discussion	List of job titles of HCWs
b. Hazards for HCWs	Slideshow	Table of hazards by job title
c. Case presentation: nurse with needle-stick	Read aloud by student	Discussion of case
d. Bloodborne pathogens	Slideshow	Discussion of content
e. Risk factors for bloodborne pathogens	Small group: read three fact sheets	Qualitative assessment of risk to nurse in case
f. Triangle of infectious diseases	Guided discussion	List of host factors, agents, and exposure conditions for case
g. Generalizing individual risk	Guided discussion of sentinel events	Decision about next steps—surveillance for individual and other HCWs
h. Incident reports	Filling in form	Incident report for nurse in case
i. Reporting surveillance data	Students given data from one year of surveillance in a hospital	Letter to head of hospital summarizing data and recommending program
2. Qualitative exposure/health assessment: hospital walk-through		
a. Preparation for walk-through	Guided discussion	List of reasons to conduct, areas to survey, activities to complete, expected hazards
b. Development of checklist	Discussion, review of resources	Checklist to be used for walk-through
c. Hospital walk-through	Walk-through of laundry, patient care area	Completed checklist
d. Debriefing	Guided discussion	Report of hazards, exposure, risk
e. Hazard prioritization	Exercise	Ranked list of hazards by priority for intervention
3. Intervention		
a. Forming a hospital health and safety committee	Guided discussion	Plan for committee development
b. Developing a needle-stick policy	Guided discussion	Plan for needle-stick policy
Module: Agriculture sector		
1. Sentinel health/hazard event		
a. Case presentation	Read aloud by student	Case discussion
b. Taking an occupational history	Role-play	Role-play exercise
c. Occupational history	Students take history from one another	Completed occupational history forms
d. Categorizing hazards	Students describe partners' history	Instructor categorizes hazards on board in front of students
e. Sentinel health event	Guided discussion	Application of concepts to case presented
2. Qualitative exposure assessment		
a. Definition of terms and concepts	Guided discussion	List of factors to characterize workforce, agents, health effects, and existing controls
b. Information gathering	Guided discussion, review of resource materials	Completed checklist for information gathering
c. Walk-through survey (virtual)	Slides of pesticide application	Completed table describing tasks, number of workers at risk, hazards, and controls
d. Chemical exposure	Guided discussion; review of MSDS and labels from pesticides	Analysis of value and drawbacks of MSDSs and product labels
3. Defining exposure and hazard judgment		
a. Introduction to terms and concepts	Lecture	
b. Classifying/grouping exposure	Guided discussion	Classification of job titles into similarly exposed groups
c. Rating exposure and health events	Guided discussion	Completed chart describing exposure and health effect ratings

continued on p. 173

Figure 3 (continued). Description of content topics, activities, and products of the courses comprising the World Health Organization Modules in Occupational Health

Content topic	*Activity*	*Student work product*
4. Quantitative assessment		
a. Surveillance	Guided discussion	Discussion of content
b. Quantitative exposure assessment	Survey development	Questionnaire for local health-care providers on pesticide poisoning
c. Quantitative exposure assessment	Guided discussion	Exposure assessment strategy
5. Interventions		
a. Exposure reduction	Lecture/discussion	Understanding hygiene hierarchy of controls
b. Exposure reduction	Group exercise	Report of planned interventions
c. Policy intervention	Create a message for policy makers	Poster communicating need for workplace prevention
Module: Manufacturing sector		
1. Sentinel health event		
a. Case study	Read aloud	Group discussion of case and sentinel health events concept
b. Conducting an incident investigation	Lecture	Discussion of content
c. Conducting an incident investigation	Role-play	Role-play exercise
d. Reporting an incident investigation	Group activity to write report	Presentation to class with guided discussion
2. Qualitative assessment		
a. Taking an occupational history	Students take history from one another	Completed occupational history form
b. Categorizing hazards	Students describe partners' history	Instructor categorizes hazards on board in front of students
c. Source and hazard identification and characterization; preparing to visit a workplace	Review of work process	Schematic diagram of work process
d. Chemical safety cards	Reviewing international chemical safety cards	Completed questionnaire about safety cards for specific agents
3. Surveillance		
a. Systematic approach to surveillance	Slideshow	Discussion about surveillance
b. Designing a questionnaire	Guided discussion	List of who to survey, how to administer, what to ask
c. Categorizing questions on a survey instrument	Individual exercise	Completed worksheet to categorize questions in a typical survey
d. Selecting questions for the survey	Guided activity	Survey instrument
e. Reviewing survey results	Guided discussion	Review of results given to students
f. Analyzing survey results	Guided discussion	Chart matching adverse health outcomes with specific exposures
4. Quantitative assessment		
a. Prioritizing hazards	Group activity	Rating exposure, health effect, and grouping job titles; discussion
5. Risk communication		
a. Overview of risk communication	Slideshow	Discussion of content
b. Developing a communication tool	Making a poster	Poster displaying risk message

HCW = health-care worker

MSDS = material safety data sheet

Content evaluation

Materials were sent for evaluation to international experts in health, hygiene, and education, leading to a reworking of the materials. Specific criticisms included recommendations to: (*1*) harmonize the content with existing information and materials coming out of the ILO, (*2*) focus more on prevention rather than reacting to sentinel health events, (*3*) emphasize the framework (Figure 1) in the beginning of each module and in each course, (*4*) include country-relevant resources, (*5*) rework the incident investigation in the manufacturing module, and (*6*) consider selecting other illnesses or injuries. These changes were either made or reasons for inability to implement the changes were explained.

Program efficacy

Efficacy initially was demonstrated through pilot testing on public health, medical, and engineering students in the U.S. in occupational health, hygiene, industrial design, and family medicine courses. Content acquisition was determined through dynamic testing (via the Socratic method in clinical medicine) and in written exams. Additional pilot tests on audiences in Ukraine, Turkey, Costa Rica, and South Africa were conducted. Students in these international settings assessed whether their knowledge improved in specific areas, whether and how the course content was relevant to their work, whether they would take another course taught in this mode, which activities they thought did and did not work well, and what additional training they would like to have. Posttesting demonstrated improved knowledge of content.

Course effectiveness

Evaluation of effectiveness depends on the ability to access target populations, allow the implementation to vary on the basis of real-world conditions, and demonstrate that the intervention has an impact.[21] For this program, target populations are professionals in developing nations who are either charged with the responsibility of protecting workers' health or could have a role in preventing workplace injury and illness; audiences may vary from country to country. For example, primary care providers may be nurses, doctors, or community health workers; labor inspectors may come from the government, NGOs, or unions; and health and safety personnel could be employed by enterprises or unions.

Real-world conditions relate to instructors, course settings, and differences in the way content is typically delivered in the settings in which it is being taught. Who has the expertise and interest in delivering this content—academic professionals, union officials, or public health ministries? In which settings could it be delivered—at informal sessions, or where continuing education or training is mandated by law? What are the education delivery modes that work best—lecture, small group activity, Internet delivery, or reinforcement?

Additionally, the program's long-term impacts need to be considered. Who has requested this program? How many times has the content been used? How has the content been altered for different audiences, instructors, and settings? How many individuals have undergone training and what is their professional make-up? How have participants utilized what they learned—to conduct preventive activities in the workplace, the community, or at the government level? And, ultimately, how have these programs impacted the number and rate of occupational injuries and illnesses?

Given the scope of this work, the long-term effectiveness evaluation process began by obtaining connoisseur evaluations of the content as it was being delivered in a classroom setting in South Africa. The audience included professionals from clinics (doctors and nurses), communities (community health workers and worker advocates), and government agencies (ministries of health and labor). The course was delivered by those who produced the modules, with expertise in hygiene, health, and education. It was evaluated in real time by an occupational health education specialist from the U.S. as well as an occupational nurse and a physician from South Africa.

Evaluators focused on the questions of whether (*1*) the program was targeted to the needs of the audience for whom it was written, (*2*) the objectives were appropriate, (*3*) the content met the objectives, (*4*) the delivery mode was effective, and (*5*) the materials could be used off the shelf and/or with simple modification by other instructors. The connoisseur evaluations and the student evaluations were used to fine-tune the content and adjust the mode of delivery. The additional two modules—manufacturing and service sectors—were developed after this evaluation was completed to better respond to the critiques. Since that time, all three modules have been modified after being used with audiences in the U.S., Turkey, Ukraine, and Costa Rica.

Dissemination

Dissemination of the program entails making the materials available and supporting their use. To date, dissemination has occurred in the following ways:

- Number of students participating in at least one of the 16-hour courses: 135;

- Number of students participating in shorter activities from the course: about 300;
- Number of copies disseminated: 60 CDs to students and faculty at India training in 2008, 200 CDs mailed by the U.S. National Institute of Occupational Safety and Health in 2007, 50 copies distributed at the International Commission on Occupational Health (ICOH) meeting in 2003, and 50 copies given to WHO Collaborating Centers partners;
- Sessions taught at the following international meetings: a two-hour session with 24 participants at ICOH in Iguassu, Brazil, in 2003; and another session at the International Occupational Hygiene Association in Pilansburg, South Africa, in 2005; and
- Current availability: can be downloaded free of charge on the Internet at http://uic.edu/sph/glakes/who_modules. Thus far, it has received 57 hits and a plan is in place to contact those who have downloaded materials to evaluate the reach of the training and fidelity to the original program.

As of spring 2008, two countries have requested collaborative support to use these training materials specifically to expand in-country training.

DISCUSSION

Evaluations of occupational training programs have demonstrated that participants have an increased awareness of hazards, a greater knowledge of risk factors and their control, and an ability to identify safe work practices that can prevent workplace illness and injury. The four levels of program efficacy for worker training programs that could be measured include: (*1*) reaction measures (trainees' ratings of the value and quality of instruction), (*2*) knowledge gained or skills developed (post-training quiz or performance test), (*3*) behavioral change (self-report or workplace observation), and (*4*) organization impact (reduction in injury and illness rates, workers' compensation claims, absenteeism, as well as cost savings).[20]

Worker training is the lowest tier of prevention, given that it relies on individual worker behavior for illness and injury prevention. This ignores the fact that individuals work within an environment of hygiene and safety controls and culture, which they typically do not have the power to manage. In a given workplace, a second tier of health and safety performance depends on the actions of owners, managers, supervisors, and equipment designers. These individuals are directly responsible for engineering controls, administrative controls, and provision of personal protective equipment, as well as the internal rules and culture that encourage employees to work safely. For this group, educational program efficacy would be the same as for workers, expecting that impact on the organization (individual company), in the form of reduced illness and injury, could be greater, as the action they take would affect the entire company. A third tier of prevention in work settings comes in the form of policy incentives—legal mandates for control of health and safety hazards and enforcement of protective laws. Powerful laws and real enforcement could affect groups of employers or entire sectors.

The personnel who would best be trained through this program are those in the third tier—the policy makers and enforcers who can impact workplace health and safety systemically and systematically for society as a whole. Others who would benefit from this training are those that have the ability to influence the second tier (owners, managers, and designers) through consultation for implementation of individual workplace hygiene and safety controls; and those who have the ability to influence individual workers through recognition of sentinel health events or sentinel exposures and the understanding of the role of individual precautions in the scheme of workplace health and safety.

CONCLUSION

The WHO Modules in Occupational Health are available for use by teachers and trainers of personnel who are charged with implementing workplace safety and hygiene programs; policy makers whose role it is to safeguard the health and safety of the working public; clinical personnel who evaluate and treat occupational illnesses and injuries; and NGO advocates of worker health and safety. The modules are available for download and use at no cost at http://uic.edu/sph/glakes/who_modules.

Linda Forst is a Professor, Leslie Nickels is a Lecturer, and Lorraine Conroy is an Associate Professor in the Division of Environmental and Occupational Health Sciences at the University of Illinois at Chicago School of Public Health in Chicago, Illinois.

This work was supported, in part, by the World Health Organization Occupational Health Group and by the National Institute of Occupational Safety and Health Training Program Grant #T42/CCT522954-01.

Address correspondence to: Linda Forst, MD, MPH, Division of Environmental and Occupational Health Sciences, University of Illinois at Chicago School of Public Health, 2121 W. Taylor, MC 922, Chicago, IL 60612; tel. 312-355-3826; fax 312-413-9898; e-mail <Forst-L@uic.edu>.

REFERENCES

1. Eijkemans GJ, Takala J. Moving knowledge of global burden into preventive action. Am J Ind Med 2005;48:395-9.
2. Leigh J, Macaskill P, Kuosma E, Mandryk J. Global burden of disease and injury due to occupational factors. Epidemiology 1999;10:626-31.
3. Takala J. Introductory report: decent work—safe work. 16th World Congress on Safety and Health at Work; 2002 May 27; Vienna.
4. Driscoll T, Takala J, Steenland K, Corvalan C, Fingerhut M. Review of estimates of the global burden of injury and illness due to occupational exposures. Am J Ind Med 2005;48:491-502.
5. Takala J. Global estimates of fatal occupational accidents. 16th International Conference of Labour Statisticians; 1998 Oct 6–15; Geneva.
6. Takala J. Global estimates of fatal occupational accidents. Epidemiology 1999;10:640-6.
7. World Health Organization. Occupational health. 2005 [cited 2008 Sep 2]. Available from: URL: http://www.wpro.who.int/health_topics/occupational_health
8. International Labour Organization. C161 Occupational Health Services Convention. 1985.
9. World Health Organization. Global strategy objectives and actions for occupational health for all. 1994 [cited 2008 Sep 2]. Available from: URL: http://www.who.int/occupational_health/publications/globstrategy/en/index6.html
10. Institute of Medicine. Safe work in the 21st century: education and training needs for the next decade's occupational safety and health personnel. Washington: National Academies Press; 2000.
11. Goldstein G, Eijekemans G. WHO-ILO joint effort on occupational health and safety in Africa. Presented at the Occupational Health for Workers in the Informal Sector Conference; 2000 Oct 16–20; Pretoria, South Africa. Also available from: URL: http://www.who.int/occupational_health/publications/en/oehafropretoria.pdf [cited 2008 Sep 2].
12. Vezina M, Saint-Arnaud L. From occupational medicine to community health in French-speaking Africa. Sante 1994;4:111-4.
13. Regional Center for Occupational Safety and Health. Regional project for Central America on occupational health and safety in Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, and the Dominican Republic. 2000 [cited 2008 Sep 2]. Available from: URL: http://www.oas.org/udse/cersso/documentos/queescerssoingles.doc
14. Bedrikow B, Lagranti E, Buschinelli JT, Morrone LC. Occupational health in Brazil. Int Arch Occup Environ Health 1997;70:215-21.
15. Yingratanasuk T, Keifer MC, Barnhart S. The structure and function of the occupational health system in Thailand. Int J Occup Environ Health 1998;4:121-30.
16. Kawakami T, Zhu C, Wang Y. Developing the national occupational safety and health profile in China. Asian-Pacific Newsletter on Occupational Health and Safety 2004;11:54-5. Also available from: URL: http://www.ttl.fi/NR/rdonlyres/EDB97AB4-BAA8-43E2-967A-E2146F6B91BD/0/AacianPasificNews304.pdf [cited 2007 Mar 20].
17. Rajgopal T. Occupational health in India—current and future perspective. J Indian Med Assoc 2000;98:432-3.
18. LaDou J. International occupational health. Int J Hyg Environ Health 2003;206:303-13.
19. Glasgow RE, Lichtenstein E, Marcus AC. Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. Am J Pub Health 2003;93:1261-7.
20. Kirkpatrick DL. Evaluating training programs: the four levels. San Francisco: Berrett-Koehler; 1994.