Incorporating an Environmental/Occupational Medicine Theme Into the Medical School Curriculum

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Medical schools have been slow in teaching students how to recognize and intervene in occupationally and environmentally related illnesses. In this article, we report on the efforts at one medical school, in which an occupational medicine physician teamed with medical school educators developed, implemented, and evaluated an environmental/occupational medicine (EOM) curriculum that was introduced in several locations, using a thematic approach. This effort resulted in new EOM content being added to eight core courses in a developmental sequence and the creation of several elective experiences. We describe techniques and strategies that might be useful at other institutions in promoting the EOM theme and improving communication. Occupational/environmental physicians and educators can play leadership roles in raising interest in EOM within the medical school setting and in developing and implementing an EOM curriculum.

Environmental and occupational factors contribute to a wide variety of illnesses and thus can involve every medical specialty. Physicians' roles in environmental health extend from the office setting, where they recognize, treat, and prevent work- and environment-related illnesses in individual patients, to the community, national, or international levels, where they can become involved in research, preventive measures, and policy strategies. The Institute of Medicine[1] and the American College of Physicians (ACP)[2,3] have urged physicians to play a greater role in recognizing and intervening in occupationally and environmentally related illnesses. Yet medical schools have been slow in responding to the need to prepare students in this area.[4,5,6] Occupational and environmental medicine physicians and educators can stimulate interest in environmental/occupational medicine (EOM) within the medical school setting and become leaders in developing and implementing EOM curriculum. Our experience at one medical school reveals educational planning strategies that may be transferable to other institutions.

Review of the curriculum at Harvard Medical School (HMS) in 1992 identified only two designated hours devoted to environmental/occupational topics. Because course directors already felt constrained by limited time, the addition of a new course or the expansion of a standing course was not a realistic remedy, so we used a longitudinal thematic ap-

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TABLE 1
Steps for Design, Development, and Integration of Longitudinal Curricular Themes*

1.	Establish goals for the content of the theme, including knowledge, skills, and attitudes
2.	Analyze the existing relevant content in the 4-year curriculum
3.	Sequence the goals in a developmentally appropriate order
4.	Determine windows of opportunity in the existing curriculum
5.	Design and implement teaching/learning strategies with course directors
6.	Inform and involve students and faculty in the theme's 4-year plan
7.	Evaluate student competencies

* Adapted from Reference 10.

proach to introduce the EOM curriculum.

Our work needs to be considered in the context of Harvard's New Pathway curriculum, which was introduced in 1985. This problem-based learner-centered approach is a hybrid program consisting of tutorial classes, laboratory sessions, and a limited number of lectures.[7] Most courses are taught as blocks. To address topics such as ethics, nutrition, and prevention, which cut across scientific disciplines and course blocks, "themes" are created, which weave educational material vertically and developmentally throughout the entire curriculum.[8,9] The designation of EOM as one of the curricular themes by the Office of Education was the initial strategic step launching our program.

Curriculum Strategies and Outcomes

The process for creating and implementing the EOM theme at HMS followed seven key steps for curricular theme development[10] (Table 1). The activities and outcomes involved in each step are described below.

Determination of Objectives and Goals

Preliminary learning objectives were modified to include the competency-based recommendations for graduating medical students that were put forth by the Committee on Curriculum Development in Environmental Medicine of the Institute of Medicine in 1993[11] (Table 2). Reference to EOM learning objectives provided by the Institute of Medicine,[11] the American College of Physicians,[2] and the American Academy of Family Practice[12] added credibility to the inclusion of EOM material. Other incentives included the need to prepare students to meet legal obligations, such as state or national reporting requirements for occupational illnesses.[13]

Analysis of the Curriculum

In 1992, the existing Curriculum Index,[14] a computerized database of curricular content, did not include a code for environmental or occupational topics. Therefore, we manually scanned course syllabi for the first 2 years of the curriculum and found one lecture on occupational lung disease in the pathophysiology course and an EOM session at some of the Introduction to Clinical Medicine clinical sites. Scanning syllabi and course cases also enabled us to identify potential areas for insertion of EOM content. Subsequently, the Curriculum Index was amended to be able to search for "environmental and occupational medicine" and "work issues."

Developmental Sequencing of Program Goals and Determination of Windows of Opportunity

A plan was constructed that sequenced our goals in a developmentally appropriate order while maximizing the windows of opportunity for inclusion of EOM topics within our curriculum (Fig. 1). The plan addressed two audiences: *all* medical students and medical students with special interest in EOM.

Development of EOM Curriculum and Strategies for Implementation

During the 5 years of this project, new material has been added to eight core courses reaching virtually all students. Additional opportunities

TABLE 2
Learning Objectives and Aims

*1.	Understand and appreciate the influence of the environment and environmental agents on human health
*2.	Elicit an appropriately detailed environmental exposure history, including a work history, from all patients
*3.	Recognize the signs, symptoms, diseases, and sources of exposure relating to common environmental agents and conditions
*4.	Demonstrate an understanding of relevant epidemiological, toxicological, and exposure factors; provide understandable information about risk-reduction strategies; and discuss environmental risks in ways that exhibit sensitivity to patients' health beliefs and concerns
*5.	Identify the informational, clinical, and other resources available to help address patient and community environmental health problems and concerns
*6.	Understand the legal and ethical responsibilities of seeing patients with occupational and environmental health problems or concerns
7.	Appreciate how global environmental conditions, such as climactic changes, give rise to a variety of environmentally related diseases through direct and indirect means
8.	Provide interested students with opportunities to do research in the field of environmental/occupational health

* Adapted from the competency-based recommendations from Reference 11.

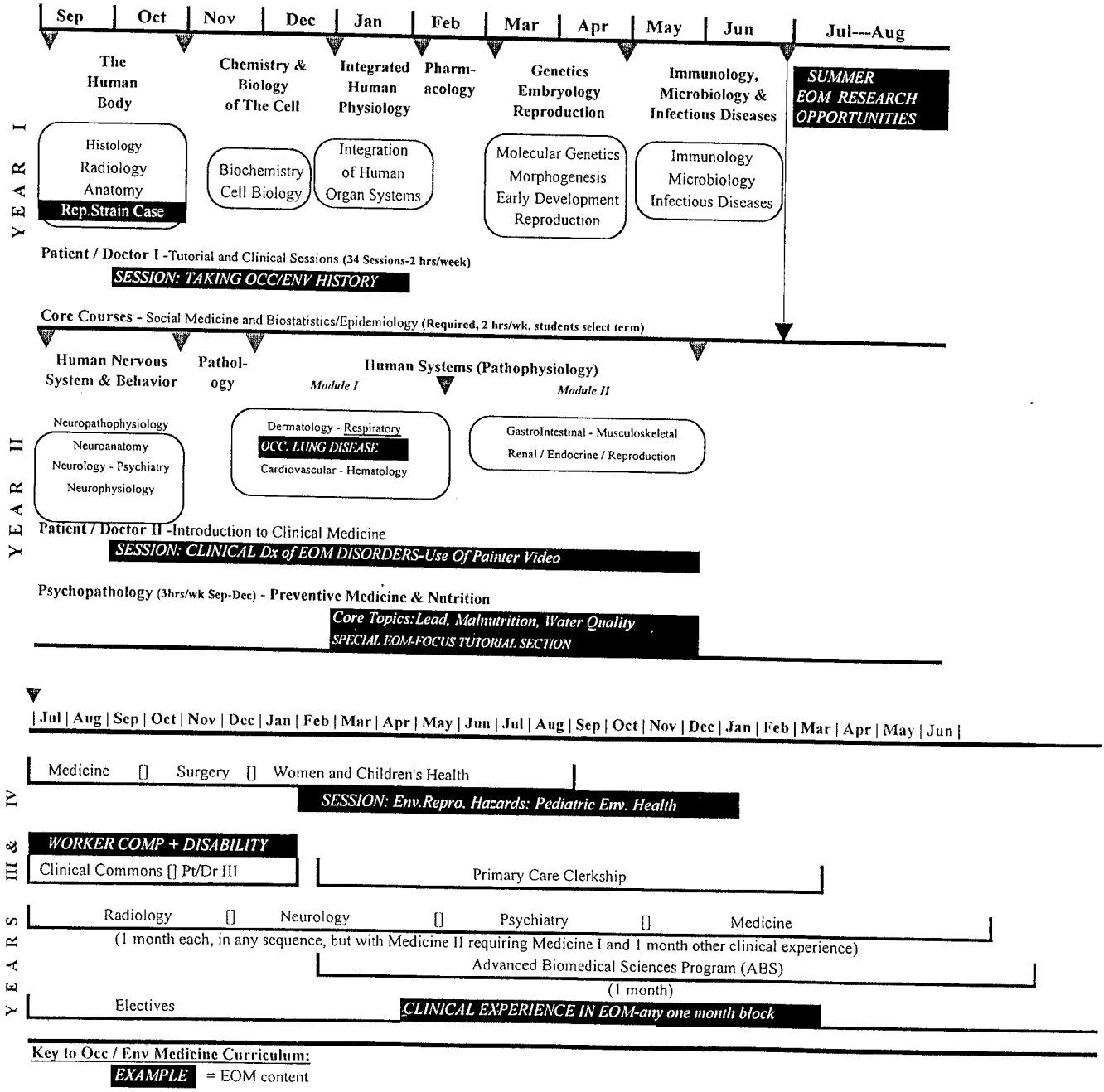

Fig. 1. Harvard Medical School curriculum map, highlighting environmental and occupational medicine content.

for interested students have included the following: provision of environmentally and occupationally-related research projects (summer between years one and two); an elective for third- and fourth-year students, Clinical Experience in Occupational and Environmental Medicine; special evening forums (eg, child labor, global environmental health issues, career opportunities in EOM); and participation in a new elective course, Human Health and Global Environmental Change. When students first encounter EOM content in year 1, they receive a curriculum map of EOM content over the 4 years that illustrates the core and optional offerings.[9]

Implementation was enhanced by listening to faculty about course needs and goals so that the EOM theme content developed could fulfill general course needs and theme objectives. As an example, course planners for the Introduction to Clinical Medicine (Patient Doctor II) course emphasized the desirability of a case (or videotape case) that could reinforce the basic course skills (history-taking, physical examination, differential diagnosis) while incorporating the occupational medicine el-

ements in the context of a clinical encounter assessment. In response, we produced an interactive videotape with a teaching guide, *Painter with New Symptoms*,[15] that has been distributed to all 12 teaching sites. The student groups view segments of the video, which prompts questions and discussion of medical and work histories, physical examination findings, laboratory testing, differential diagnoses, and prevention strategies. Eventually the diagnosis of lead poisoning is made.

The greatest sustained impact on a course curriculum occurred when one of the authors (R.G.) joined the curriculum committee of the Prevention and Nutrition course at a time when major restructuring of the course was in progress. This second-year course, which utilizes lectures and small group tutorials and examines prevention and nutrition issues throughout the life cycle, had no environmental/occupational material in the course curriculum 3 years ago. Relevant environmental health information was inserted into the existing cases (eg, prevention of lead poisoning into the infant/child case; awareness of teen work injuries into the adolescent case; and prevention of occupational injuries in the mid-life period). In addition, we wrote a new case for the adolescent section, *Nan's Lunch*,[16] which not only raised multicultural nutritional issues (another need in the course) but also provided an opportunity to address the topics of malnutrition, hunger, and water quality on a broader level.

Because of time constraints within the core course, the faculty committee created a special tutorial section with an expanded EOM focus. Led by an occupational medicine physician (R.G.), the session allowed for greater discussion of public health and environmental health issues and the development of innovative educational exercises and materials.

Extending EOM into the clinical III and IV years has been a challenge. Our strategy has been to create opportunities within the centrally offered didactic sessions that occur during the clinical clerkship time. For example, during the Maternal and Child Health clerkship's week of didactic sessions, we conducted a session on developmental and reproductive toxicology, which was subsequently broadened into pediatric environmental health. Third-year students meeting together at the medical school one afternoon per week on patient care issues (Clinical Commons course) have valued our interactive session on Impairment, Disability and Worker Compensation. Third- or fourth-year students with a particular interest in EOM can take an elective rotation, Clinical Occupational and Environmental Medicine. In this rotation, the students evaluate patients in the occupational environmental medicine clinic, attend a childhood lead clinic and poison control center rounds, and research and present a project of their choosing.

To make the EOM theme curriculum more accessible, we recently created an EOM theme Web page within HMS's Office of Education (http://www.hms.harvard.edu/oed/themes), which includes some of the curricular material (EOM history; information on specific topics, such as cumulative trauma disorders and occupational asthma) as well as lists of resources, telephone numbers, and linked Internet sites. We are developing links between this EOM Web site and other medical school course sites.

Additional Strategies for Initiating and Sustaining Faculty Support for EOM Curricular Initiatives

Formation of an EOM curriculum advisory committee, with representatives from a variety of disciplines, has generated ideas for development of theme opportunities at different points in medical school and residency curricula, as well as possibilities for student research projects. An important yet time-consuming aspect of faculty collaboration has been the need to communicate with and educate individual faculty concerning the relevance of EOM to their course. EOM presentations at course-related faculty workshops and regional workshops for medical school deans and course leaders, key course faculty, or committees have also helped to promote this new content.

Another useful strategy has been to build a team of faculty (including non-EOM specialists) who can serve as advocates for the development and inclusion of these topics in their respective courses. As an example, an internist faculty course leader for the Patient Doctor I interviewing course was instrumental in creating and maintaining a key new session, Occupation and Environment: Relevance to Illness. In addition, we have collaborated with other HMS faculty who developed a Center for Health and the Global Environment and an elective course open to all Harvard University students, Human Health and Global Environmental Change (refer to the Web site: www.med.harvard.edu/chge/).

Bringing together the eight different curricular theme directors (those for EOM, prevention, HIV, ethics, addictions, geriatrics, nutrition, and violence) with a medical educator (E.A.) and the Dean for Medical Education for a biannual meeting has facilitated the identification of intersecting content areas and common barriers for implementing theme curricula. Two initiatives were undertaken to address the problem of limited communication with course directors: attendance of some theme directors at course curriculum planning meetings and the creation of theme Web pages that can intersect with course Web page material.

Stimulation of Student Support

In an orientation survey given to all incoming first-year students, we included questions to identify those with experience or interests in the field of environmental/occupational

health and general public health. Orientation survey results from 1996 demonstrated that in an HMS class in which 75% have had experience working in a science laboratory and 70% have worked in a hospital with patients, a much smaller number, 13% (9/145), reported some medical public health experience and 3% (5/145) listed environmental or occupational health research or service. Eight students (6%) were considering a career specifically in environmental/occupational health and 52 (36%) in the broader area of preventive medicine. Identification of such students facilitates early outreach to those who might be interested in student elective experiences and collaborations.

The summer between the first and second year is a good time for students to do research or service projects. Prior to 1992 we identified no student projects in the area of environmental health. With support from a National Institute of Environmental Health Sciences/National Institutes of Health award and matching funds from HMS, we were able to place at least two students per year on projects involving environmental health issues. To facilitate student research or alliances with EOM faculty, we collaborated in the production of a student guide to faculty doing research in this area.

Interested students (mostly first- and second-year students) have formed and participated in a student environmental health group that arranges for lunchtime speakers and conferences.

In 1993, a review of the Career Day agenda and list of career specialists revealed no listings for preventive medicine, public health, or EOM. As a result, a new position was created for career counseling in these areas. Lunchtime introductory career talks and evening forums have provided information about different EOM career and training paths, spanning research and academics, government, education, policy, and clinical occupational medicine.

Evaluation of Student Competencies

First-year students are evaluated on their interviewing skills by observation as they interview standardized patients. The evaluation work-sheet did not contain a specific category to address EOM history in 1994–1995. For the 1995–1996 school year, the following items were added to the assessment form: "Impact of illness on job/home life?" and, under "Past Medical History," "Occupational and Environmental History?"

Evaluation sheets were reviewed for 3 years and showed that reporting of an occupational history increased from 25% (31/130) in 1995 to 71% (94/132) in 1996 and 68% (109/161) in 1997. The quality of the information obtained also improved, with specific questions about exposures and use of protective equipment noted in the 1997 work-sheets of students evaluating a new standardized patient who was a machinist.

Increased attention to the occupational and environmental history noted on the assessments may result in part from the addition of a whole session devoted to the topic during the course. Some of the apparent increase may also be attributed to changes in recording practice. Also, the inclusion of a standardized patient (a machinist) whose job had more obvious environmental exposures may have prompted more attention to work activities.

Second-year students are evaluated at the end of the Introduction to Clinical Medicine course (Patient Doctor II) with Observed Structured Clinical Evaluations. A 12-minute history-taking station presented a patient with headache. It required students to include an occupational and environmental history in their medical history for headache in order to identify the cause of the symptoms as carbon monoxide poisoning.[17] The "Headache" station evaluated students' mastery of the first three EOM objectives (Table 2). In the first year of using the "Headache" Observed Structured Clinical Evaluation, 45% (74/163) asked questions about environment and occupation without any examiner prompts. Fifty-six percent (91/163) identified carbon monoxide poisoning correctly as the most likely diagnosis. To contrast with another medical history-taking station, "abdominal pain," 40% (65/163) identified pancreatitis correctly as the most likely diagnosis.

Third- and fourth-year students on the Clinical Environmental and Occupational Medicine rotation are evaluated on their patient write-ups, follow-up of patient issues, and project presentation.

Program Evaluation

Student and faculty evaluation of course EOM material was assessed with feedback surveys at the conclusion of EOM sessions. Suggestions are frequently incorporated into future sessions.

Discussion

Without a separate designated course in EOM, we were able, using a thematic approach, to create and introduce considerable new EOM material in a developmental sequence throughout the curriculum. Encountering EOM issues in different courses reinforces the relevance of this material to a broad spectrum of medicine. However, maintaining an updated, integrated curriculum in the face of annual changes in the various targeted courses has required constant vigilance, advocacy, and effort. Like course directors, theme directors require ongoing support from the institution. Support should include compensating faculty time and facilitating access to other curriculum materials, developments, and annual changes.

Finding the appropriate "windows of opportunity" within the curriculum for the introduction of EOM is specific to the individual medical school and may depend on current course content, course structure, and the amenability of course directors.

Nevertheless, there are a number of generic course topics covered at different medical schools that could serve as targets for core EOM material. A useful starting point is the Institute of Medicine's book *Environmental Medicine: Integrating a Missing Element into Medical Education*,[18] which provides ideas for access points for integrating environmental medicine in medical school courses and clerkships and provides examples of written teaching cases and pertinent case reports from the literature. Occupational medicine physicians can play a critical role at their affiliated medical schools in finding the best access points in their curriculum and then adapting currently available teaching materials or using illustrative cases from their own experiences.

Our approach to EOM theme integration at HMS has utilized a centrally managed curriculum. While some obstacles associated with the insertion of EOM material were overcome through access to planners, medical educators, and course materials, we found that much still needs to be done to improve communication systems among course leaders and theme directors. Strategies to improve communication and to promote the EOM theme include the following: joining course-planning committees; creating special EOM-interest tutorials; developing course materials that meet course as well as EOM content needs; gaining faculty support through "networking" and educational workshops; and gaining student support through providing special summer projects, rotations, tutorials, career counseling, and support for student EOM-interest groups. To provide the sense of cohesion without a specific course schedule or course syllabus per se, it can be helpful to create a curriculum map with the highlighted EOM content areas, as well as an accessible compilation of theme curriculum material and contact people, via written handbook, Web page on a school Intranet, or portable computers.

By using the techniques and strategies that we have found useful, we hope that other EOM physicians will be able to work with their affiliated institutions to successfully introduce important environmental and occupational health topics in a thematic way into the curriculum.

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