

Evidence-Based Public Health Education as Preparation for Medical School

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Abstract

The Institute of Medicine has recommended that all undergraduates have access to public health education. An evidence-based public health framework including curricula such as "Public Health 101" and "Epidemiology 101" was recommended for all colleges and universities by arts and sciences, public health, and clinical health professions educators as part of the Consensus Conference on Undergraduate Public Health Education. These courses should foster critical thinking whereby students learn to broadly frame options, critically analyze data, and understand the uncertainties that remain. College-level competencies or learning outcomes in research

literature reading, determinants of health, basic understanding of health care systems, and the synergies between health care and public health can provide preparation for medical education. Formally tested competencies could substitute for a growing list of prerequisite courses. Grounded in principles similar to those of evidence-based medicine, evidence-based public health includes problem description, causation, evidence-based recommendations for intervention, and implementation considering key issues of when, who, and how to intervene. Curriculum frameworks for structuring "Public Health 101" and "Epidemiology 101" are provided by the Consensus

Conference that lay the foundation for teaching evidence-based public health as well as evidence-based medicine. Medical school preparation based on this foundation should enable the Clinical Prevention and Population Health Curriculum Framework, including the evidence base for practice and health systems and health policy, to be fully integrated into the four years of medical school. A faculty development program, curriculum guide, interest group, and clear student interest are facilitating rapid acceptance of the need for these curricula.

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The Institute of Medicine (IOM) has recommended that "all undergraduates have access to education in public health."¹ In November 2006, a Consensus Conference on Undergraduate Public Health Education made specific recommendations to operationalize this recommendation. The participants recommended that "Public Health 101" and "Epidemiology 101" be offered by all of the approximately 2,000 colleges and universities in the United States. In doing so, the participants saw these curricula as part of general education designed to produce an educated citizen. They also recognized that inclusion of undergraduate public health content could be excellent preparation for health professions education, including medicine.²

The Consensus Conference on Undergraduate Public Health Education was convened in 2006 to implement the specific recommendations for undergraduate public health education. The conference was supported by a grant from the Josiah Macy, Jr. Foundation and was sponsored by the Association for Prevention Teaching and Research (APTR), the Association of Schools of Public Health (ASPH), and the Council of Colleges of Arts and Sciences. The Association of American Colleges and Universities (AAC&U) and the Centers for Disease Control and Prevention (CDC) participated in the Consensus Conference, as did representatives of the seven health professions that constitute the Healthy People Curriculum Task Force, including allopathic and osteopathic medicine.

These participants developed a set of recommended learning outcomes or competencies for undergraduate public health education. These learning outcomes may serve as the intellectual link for articulating the connection between undergraduate public health education and medical education. The learning outcomes include an emphasis on gaining a big-picture or population perspective on health and health care.³

The recommendations of the Consensus Conference are consistent with the 1998 recommendations of the Association of American Medical Colleges' (AAMC's) Medical School Objectives Project report on medical informatics and population health. In that report, a population health perspective was recommended for all medical students and was defined as such: "a population health perspective encompasses the ability to assess the health needs of a specific population; implement and evaluate interventions to improve the health of that population; and provide care for individual patients in the context of the culture, health status, and health needs of the populations of which that patient is a member."⁴

The first portion of this definition, that is, the ability to assess the health needs of a specific population and implement and evaluate interventions to improve the health of a specific population, is grounded in what is increasingly being called evidence-based public health.⁵ Evidence-based public health encourages broad-based systems thinking examining the evidence for a range of options from prevention, to cure, to rehabilitation. Evidence-based public health frames questions such as what are the options for

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addressing the AIDS epidemic, rather than jumping to traditional approaches such as how can we develop a vaccine or drug treatment.

Data from the ASPH and the APTR obtained as part of their ongoing data-collection process indicate that more than half of the approximately 40 accredited schools of public health and over 60 accredited programs in public health, located mainly in medical schools in the United States, offer introductory undergraduate public health course work, usually including an introduction to public health and epidemiology. An increasing number of these institutions are offering academic minors, and a small number are offering majors either through public health directly or through arts and sciences.⁶

An informal survey conducted in 2006 through the ASPH's Task Force on Undergraduate Public Health Education suggests that a majority of students who enroll in existing undergraduate public health and epidemiology courses plan careers in medicine, and a substantial minority of graduates of these courses do go on to medical school. Most institutions offering introductory public health and epidemiology courses to undergraduates have found that these courses are very popular, often resulting in students being turned away or the institutions having to open the classes to more students. Institutions are increasingly offering multiple sections of introductory courses to accommodate the students' interest (personal communication). Despite the growing popularity of undergraduate public health education in institutions with graduate public health education, courses in public health are still unusual in other undergraduate institutions.

To facilitate the introduction of undergraduate public health and epidemiology courses based on these learning outcomes into the approximately 1,900 colleges and universities without graduate public health education, a series of recommendations for implementation were made by Consensus Conference participants. These included a recommendation that clinical health professions, including medicine, encourage applicants to enroll in undergraduate public health and epidemiology curricula. The recommendations also encouraged

faculty- and curriculum-development efforts. Activities designed to implement the faculty- and curriculum-development recommendations are underway through the APTR in collaboration with the AAC&U.⁷ These efforts include faculty development workshops and the development of a Curriculum Guide for Undergraduate Public Health Education, available at (www.teachpublichealth.org).

In addition, the Web-based Prevention Education Resource Center (www.teachprevention.org) is being developed under the auspices of the APTR to provide a range of curriculum materials for public health and clinical education, and it includes education materials designed for undergraduate public health education. Materials are available to develop an "epidemiology laboratory" to enable epidemiology to fulfill a science distribution requirement, providing hands-on experience using evidence. An undergraduate public health "interest group" is organizing a growing network of public health, arts and sciences, and clinical health professionals interested in teaching undergraduate public health. Information about these efforts is available at (www.teachpublichealth.org).

Why Connect Undergraduate Public Health with Medical Education?

Almost a decade ago, the AAMC encouraged the inclusion of a population health curricula as part of the four years of medical school.⁴ The Healthy People Curriculum Task Force, consisting of representatives from seven clinical health professions educational organizations, including allopathic and osteopathic medicine, has since produced the Clinical Prevention and Population Health Curriculum Framework.⁸ This framework includes specific recommendations for teaching the evidence base for medical practice, clinical preventive services and health promotion, health systems, and health policy and community aspect of practice as part of the basic degree programs of clinical health professions including medicine.

Data from the AAMC⁹ and an article by Garr and colleagues¹⁰ suggest that medical schools are doing an increasingly good job of teaching clinical prevention and health promotion. The larger issues of instructing students about health

systems, health policy, and other aspects of population health fare less well.

In addition, a recent study of residents from Yale indicates that their knowledge of study design and statistical analysis is inadequate for reading the medical literature. The authors attribute this to inadequate, elementary, and one-shot introductions of study design and data analysis to medical students. They recommend that a more sophisticated and integrated approach be incorporated into expanded teaching of evidence-based medicine.¹¹ Teaching evidence-based public health to undergraduates should make it far easier to teach evidence-based medicine to medical students and residents.

Under the assumption that there is and will be only a limited amount of time in medical school to achieve these goals, an alternative is to bolster these efforts with adequate preparation as part of undergraduate or college education. One approach is to rely on a growing list of prerequisite courses for medical school. Given unlimited time for medical school preparation, a comprehensive list of prerequisite courses might be desirable. However, given the competing demands of undergraduate education, we believe that the alternative of defining competencies in evidence-based public health as well as other key areas of preparation for medical school seems desirable and more acceptable from the perspective of medical educators, college educators, and students.

The success of this competency-based alternative requires

- defining competencies or learning outcomes that candidates for medical school need to achieve and providing a testing mechanism to ensure fulfillment; and
- articulating these competencies with curricula in medical school that build on basic understandings, reinforcing the curricula throughout the four years of medical school, and viewing these competencies as an inherent part of the education of physicians.

How Can Competencies Serve as the Basis for Connecting Evidence-Based Public Health and Medicine?

Evidence-based public health needs to be solidly grounded in epidemiology.

Although epidemiology may be taught merely as a technical skill, it can and should be used to develop in students a population or big-picture perspective on health issues. These are foundations for

teaching evidence-based medicine as well as evidence-based public health.

The recommendations of the Consensus Conference include a series of

competencies that may serve as the basis for connecting undergraduate public health education with medical education. These are stated here as understandings. The specific measurable learning

Table 1
"Public Health 101" Curriculum Framework and Learning Outcomes

Framework topic	Learning outcome
Overview and basic principles	
Context and scope of public health, including history, philosophy, literature, essential services, ethics, and applications to current events — Public health placed in historical and modern perspective	Identify eras in the historical development of public health and ways that public health affects literature and the arts, current events, and everyone's daily life
Public health as cross-cutting and systematic — Interdisciplinary concepts introduced early and integrated throughout the course (e.g., examining the options for interventions to address public health concerns)	Illustrate the interdisciplinary, cross-cutting character of public health and the contributions of a range of disciplines and professions to improving health Explain how public health assesses the options for intervention to improve the health of a population
Epidemiologic principles and population perspective — Rates, risk factors, and health status indicators of morbidity and mortality; disease determinants, causation, and types of epidemiologic research; and public health surveillance and vital statistics*	Explain the basic principles of epidemiology, including rates, risk factors, disease determinants, causation, and public health surveillance
Population health tools	
Health communication and informatics — Accessing and evaluating the quality of health information and data in the mass media, including the Internet	Explain how public health can utilize health information and health communications to improve the health of populations
Health and social and behavioral sciences — Impact on health and methods for altering behaviors at the individual and population levels	Identify how public health can utilize social and behavioral interventions to improve the health of populations
Health policy, law, and ethics — Tools for implementing health decisions and potential tensions between individual rights and social responsibilities	Explain how public health can utilize health policy and law to improve the health of populations
Disease and disability: Determinants, burdens, and interventions	
Environmental health and safety — Impact, control	Identify the impact of the environment on the health of populations
Communicable diseases — Prevention, detection, and control from a population perspective	Identify the impact of communicable diseases on the health of populations
Noncommunicable diseases — Effects on longevity and quality of life including demographic and epidemiology transitions and methods to prevent, detect, cure, and minimize impacts	Explain the burden of chronic diseases on morbidity and mortality and approaches to prevention and early detection
Health-care and public health systems	
Health workforce — Professionals' roles and options within the health-care and public health workforce	Describe the contributions of health professionals
Organization of health-care and public health systems — Institutions and structures of health-care and public health systems, both national and international; the distinct roles and complementary responsibilities of health care and public health systems; and the mechanisms, including insurance systems, for paying for health services	Describe the basic organization of health care and public health systems Identify the basic payment mechanisms for providing health services and the basic insurance mechanism for paying for health services
Costs, quality, and access to health-care and public health services — Reasons for health-care costs, criteria for quality, and effects of inadequate access	Describe criteria for evaluating health systems including issues of access, quality, and cost
Special public health education focus areas	
Health disparities and vulnerable populations — Overview of public health's commitment to vulnerable populations, including maternal and child care, aging, persons with disabilities, and socio-economically disadvantaged populations	Identify the roles of public health in addressing the needs of vulnerable populations and health disparities
Public health preparedness and disaster management — Essential roles of public health in preparedness for and response to natural or terrorism-related disasters	Identify the roles of public health in disaster prevention and management
Global health — The burden and distribution of disease, effects of globalization, and potential for collaborative solutions†	Describe the burden of disease in developing countries, health implications of globalization, and potential collaborative solutions

* These basic concepts are needed for reading and understanding public health subject matter. The approach should be compatible with Epidemiology 101.

† Global health also might be taught as a separate introductory course.

Table 2

“Epidemiology 101” Curriculum Framework and Learning Outcomes

Framework topic	Learning outcome*
History, philosophy, and uses of epidemiology	
Historical contributions and modern uses of epidemiology — Development of epidemiologic thinking and placement of epidemiology in historical and modern perspective	Describe the historical roots of epidemiologic thinking and their contribution to the evolution of the scientific method
Ethics and philosophy of epidemiology — Appreciation of the links between epidemiology and broader ethical and philosophic traditions and concerns	Explain how ethical principles affect epidemiological research
Descriptive epidemiology	
Condition, frequency, and severity — The basic tools of epidemiologic analysis, including case definitions and populations, incidence, prevalence, and case-fatality rates	Use rates and proportions to express numerically the amount and distribution of health- and non-health-related outcomes
Data regarding disease or injuries — Vital statistics, public health surveillance, and measures of health status, including methods for describing quantitatively the natural history, frequency, and changes in infectious and chronic diseases and injuries	Describe the sources of data and how they can be utilized to describe a health problem as the basis for evidence-based public health
Patterns of disease and injuries — Application of the basic tools of epidemiology to generate hypotheses regarding person, place, and time; changes and differences in rates; exposures; incubation periods; and disease spread	Use the distribution of a health-related outcome to generate hypotheses that might provide an explanation
Association and causation	
Estimation — Measures of strengths of association, graphical display of data, risk, relative risk/risk ratios, attributable risk, and population attributable risk	Explain basic statistical and epidemiologic concepts and approaches to estimation
Inference — Concepts of statistical significance and confidence intervals	Explain the basic statistical and epidemiologic concepts of inference
Bias, confounding, and adjustment — Identification of bias, confounding, and effect modification/interaction and methods to prevent and take into account their impact	Explain the basic statistical and epidemiologic concepts of bias confounding, and effect modification/interactions
Causation — Risk factors and other determinants of diseases and conditions	Explain how to use evidence of an association to make a judgment about whether an association is causal
Analytic epidemiology	
Basic epidemiologic study designs and their application to population health, including ecologic or population comparison, cross-sectional, case-control, and retrospective and prospective cohort studies	Describe the basic epidemiologic study designs that are used to test hypotheses, identify associations, and establish causation
Experimental studies — Randomized clinical trials and community trials and their applications to the efficacy and effectiveness of disease or injury etiology and the efficacy and effectiveness of interventions	Describe basic concept of randomized clinical trials, their ethical implications, and their central role in demonstrating the efficacy of interventions
Evidence-based public health and evidence-based recommendations	
Harm, benefit, and cost analyses — Evidence-based decision analysis regarding risks, benefits, and cost-effectiveness of interventions	Describe the components of evidence-based public health and apply the concepts to a public health decision
Intervention efficacy and effectiveness — Evidence-based analyses of interventions' capacity for producing desired results and measurement of the accuracy or success of prevention and control efforts for diseases or injuries	Utilize an evidence-based public health approach i.e. problem, causation, intervention, implementation, to analyze the evidence for or against a recommendation for intervention
Applications to policy and basic and clinical sciences	
Outbreak investigation, testing, and screening — Application of epidemiologic methods to basic and clinical science	Utilize epidemiological concepts to analyze the data from an outbreak investigation Describe the concepts of measurement of test performance and be able to apply the concepts of testing and screening in different settings Describe the broad applicability of epidemiologic methods to clinical and basic science
Public health policy — Application of results from investigations and analyses to influence policymaking	Describe the applicability of epidemiological methods to health policy
Special epidemiologic applications — Molecular and genetic epidemiology, environmental and occupational health and safety, unintentional injury and violence prevention, and behavioral sciences	Describe the broad applicability of epidemiological methods to a range of disciplines

* Learning outcomes are based on the learning outcomes resulting from the Consensus Conference. However, they have been modified and additional outcomes added to fit the tabular format utilized here.

outcomes or competencies defined by the Consensus Conference participants are included in Tables 1 and 2.³

- Understanding basic epidemiological principles and their applications to study designs and to reading research literature.
- Understanding the determinants of health and disease, including, but not limited to, behavior, physical environment, and genetics.
- Understanding the basic structure of the U.S. health care and public health systems and the synergy possible through collaboration between medicine and public health.
- Understanding the range of roles and career routes in health care and public health.

Together, these frameworks are recommended as the foundation for undergraduate public health and epidemiology curricula, and they constitute the basis for evidence-based public health.

In addition to outlining competencies or learning outcomes, the Consensus Conference encouraged the development of a Curriculum Guide to Undergraduate Public Health Education. The Curriculum Guide also provides recommendations on structuring curriculum to achieve a coherent approach to evidence-based thinking, including fostering “enduring understandings” or concepts designed to be carried away from the curricula and incorporated into future education and practice. The Web-based Curriculum Guide is being developed as an ongoing joint project of APTR and AAC&U, and it is available at (www.teachpublichealth.org).

Thus, with the rapid growth in undergraduate courses in public health and epidemiology, it is will soon be possible to use this educational content as solid grounding for medical education.

What Can Teaching Evidence-Based Public Health Accomplish?

Evidence-based public health is built on what the CDC describes as the following four components¹²:

- **Problem.** Describe the problem using concepts from descriptive epidemiology.

- **Cause.** Examine the evidence for risk factors, causation, and efficacy, using research studies.
- **Interventions.** Evaluate a range of options from prevention to cure to rehabilitation, relying on evidence-based recommendations.
- **Implementation.** Consider a range of strategies, including patient- and population-oriented approaches for implementation, asking when to intervene, what methods to use, and at whom to target the intervention.

An evidence-based public health curriculum aims to encourage students at an early stage in their education to broadly frame options, critically analyze data, and understand the uncertainties that remain. Such critical thinking skills can and should be part of the general education for a wide range of students. For students preparing for medical school, these skills can be taught in a health context through courses in public health and epidemiology. This approach can serve as the basis for specific competencies that can be set forth as expected preparation for medical school and, if deemed appropriate, tested as part of the Medical College Admission Test.

Students who come to medical school ready to read the health research literature and discuss the determinants of health and disease should be better prepared for the self-directed learning inherent in problem-based learning. Students who understand the basic elements of the U.S. health care system should be better prepared to integrate their clinical experience into a large context. Students who understand the roles of a range of health care and public health professionals will hopefully make career decisions consistent with their interests and abilities and be prepared to learn to work with other health professionals.

The movement toward undergraduate public health education has been a student-driven movement. According to Nancy Alfred Persily, an early implementer of undergraduate public health education, “Students appear to be the driving force behind undergraduate public health education. Public health helps them understand people and populations and delivery of care. Students want to learn more about the

health of the community and society.”⁹ It is time that public health, arts and sciences, and medical educators join this movement as well.

Conclusions

Teaching of evidence-based public health as preparation for medical school will greatly enhance a coherent approach to teaching evidence-based medicine in the four years of medical school. Students who come to medical school with skills for reading the research literature, an appreciation of the determinants of disease, and an understanding the structure of the U.S. health care system will be better prepared to incorporate evidence-based thinking and a population perspective into their education. Medical education built on this foundation should provide invaluable service to students, the medical profession, and society at large.

A population perspective on health issues and an evidence-based approach to practice should be part of the education of all future physicians, starting at the college level and continuing throughout the four years of medical school and beyond. An undergraduate public health curriculum grounded in epidemiology provides a natural way to introduce premedical students to key concepts that they can use throughout their education and practice of medicine. Early experience strongly suggests that students are voting for undergraduate courses in public health and epidemiology with their course registrations. It is time for medical and undergraduate public health educators to work together to strengthen the connections between college and medical school.

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Teaching and Learning Moments

El médico de inmigración

Soon after we were married, the time came for the normalization of my wife's immigration status. She was from Ecuador, and had a visitor's visa. By the time I got my act together enough to start working on her immigration papers, we were already a few months pregnant. I had just begun my second year of medical school.

As part of normalization, my wife needed an "immigration physical," consisting of blood tests and vaccines that should be administered by "civil surgeons." These exams are typically expensive, so we traveled far to the office of Dr. Delphin. His rates were reasonable, but his character proved to be exceptional.

After a brief wait in his office, we entered the exam room. Dr. Delphin greeted us warmly, and he proceeded to get to know us. He wanted to know who we were, what we did, why we were there. Somewhere in the conversation, he learned that I was in my second year of medical school, and I expressed to him how I wanted to have a similar practice when I finished school. He told me that he would like to help and invited me to come back to his office the following Saturday, to help and learn.

The next week flew by, and I became busy with schoolwork. That Saturday, I forgot to go to his office. I would not have remembered it at all if it weren't for a phone call I got that night. "José," Dr. Delphin said, "I was waiting for you all day." I felt horrible, apologized profusely, and asked for a new appointment. He gave me a second chance. Since the beginning Dr. Delphin was invested in my success.

At our next meeting, Dr. Delphin taught me to draw blood. With his patients, I learned how to take blood efficiently. I went to his office regularly for the rest of medical school. Over time we became friends and our families got to know each other. We spent holidays together. Dr. Delphin became a trusted mentor.

As I reflect back on this experience, I recognize my good fortune in finding a friend and mentor in Dr. Delphin. Those hours I spent in his office were filled with advice and wisdom, and it was a place to establish clinical relevance for the much-hated book work of my second year. He taught me to respect patients, that time was worth more than money, and that my time was the greatest gift that I could give my patients. When one of his patients unexpectedly died, he spent hours with the family, in his role as physician. He taught me to be one

with the patients, and that each patient was a gift.

Our relationship never would have developed if it weren't for Dr. Delphin's interest in me. I was an overwhelmed medical student, and he was a successful practicing physician. I needed a mentor, but I did not know it. He sensed my need and became my mentor, using techniques that he knew would engage me. His influence lives in me today. My choice of career in family medicine is due to his example. My commitment to the underserved is a direct result of his teachings. My work as full-time academic physician has roots in our relationship. I now have countless opportunities to mentor medical students. But more than anything, my efforts to become a good mentor are to repay him. He taught me true mentoring, where the mentor expects nothing in return. From him I learned that the best mentoring relationships are those that develop on their own—and for that I give profound thanks.

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