The Education of Physicians: A CDC Perspective

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Abstract

The Centers for Disease Control and Prevention (CDC) strongly supports integrating population health perspectives into the education of physicians. Physicians with critical-thinking skills, a commitment to the health of a community, and a systems-based approach are critical partners for the agency in its mission to protect and promote the public's health. To cultivate such physicians, integrating population health concepts solely into undergraduate medical education would be inadequate. A multipronged approach that establishes and maintains population health concepts with physicians at all stages of their education is needed: before medical school, during medical school, during residency and fellowship, and in research and practice (particularly for faculty who train the next generation). The authors describe relevant, CDC-conducted or CDC-supported activities that support such physician education during all these stages. Based in part on recent, cutting-edge trends assimilating community health particularly into primary care residencies, the authors also offer ideas for new ways that CDC can participate in the development of physicians who are truly competent at both medicine and population health in an integrated fashion—physicians who focus on and care for individual patients but who also take a broader population or community perspective and can act effectively in either arena. Physicians who take such a systems approach—who view and understand medicine and public health as a continuum rather than as distinct arenas—are sorely needed to help solve the current health system crisis and to contribute to improving health in other ways.

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Physician education is addressed in multiple recent Institute of Medicine (IOM) reports, including *Health Professions Education: A Bridge to Quality*[1] and *Academic Health Centers: Leading Change in the 21st Century*.[2] Of particular relevance to this discussion is the recently released *Training Physicians for Public Health Careers*,[3] which builds on the 2003 IOM reports, *Who Will Keep the Public Healthy? Educating Public Health Professionals for the 21st Century*[4] and *The Future of the Public's Health*.[5] The importance of a population health perspective in preparing physicians, given their potential contribution to health (and not just to health care), is a recurring theme in all of these reports, implicitly in the first two and explicitly in the last three.

The mission of the Centers for Disease Control and Prevention (CDC) is to protect and promote the public's health. To do this effectively, CDC must partner with all segments of society, and particularly important partners are the physicians who provide clinical care, conduct research, and/or train our future cadres of health care providers. These are also the men and women who collaborate with CDC as we deal with emergent threats (e.g., hurricanes, infectious diseases, and bioterrorism) as well as ongoing urgent health priorities (e.g., obesity and smoking). Hence, educating physicians for careers not only in public health (CDC alone employs approximately 700 physicians) but also in clinical practice and academia is a critical priority for the agency. Having all physicians conversant with broader health topics, including that of public health, is essential. We contend that integrating a population health perspective into physician education will prepare tomorrow's doctors for their dual roles of contributing to the health of the public and meeting the challenges of this century.

Population health encompasses the domains of critical thinking and evidence-based practice, disease prevention and health promotion, health systems, health policy, and community health, including the broader community context for health or illness, with particular emphasis on a broad, "ecological model of health" that recognizes not only biologic/genetic but also social, behavioral, environmental, economic, and other influences on health.[4–9] Physicians with a population health perspective use such knowledge and context both to improve their clinical acumen for care of individual patients and to contribute more broadly to the health of the population. These are the bases for recommendations urging that population health be integrated into physician education, particularly during medical school.[4–8,10,11]

Population Health and Physician Education

The importance of population-based medicine is not a new concept,[12,13] but its implementation in educating physicians has been neither consistent nor effective. Social medicine—the practice of medicine concerned with health and disease as a function of group living and the community—originated in the 18th century, and academic departments were established in England in the early 1900s.[14] The preventive medicine and community medicine movements emerged during the last century,[8,15] and in 1988, the Acheson Report advocated use of the term *public health medicine*.[16]

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All of these efforts included the concept of a population health perspective and represented efforts to bridge the gap between clinical medicine and public health through changes in medical school curricula. The constant change of terms and associated approaches, however, is an indication of the failure of the concept to be accepted in medical schools to the same degree as anatomy, pathology, or internal medicine.

Perhaps the failure of population health to prevail in physician education relates, on the one hand, to a lack of understanding of either what is meant by a population health perspective or what population-based medicine is, or, on the other hand, ironically, to an in-depth understanding of the complexity and, thus, an inertia or unwillingness to address the area, given an already overcrowded curriculum. Despite the challenges, the papers in this issue of *Academic Medicine* demonstrate that exciting progress is being made, particularly in undergraduate medical education.[13,17–25] However, we cannot rely on influencing undergraduate medical education alone.

To have an impact on physician education, a multipronged approach that establishes and maintains population health concepts with physicians at all stages of their education is needed: before medical school, during medical school, during residency and fellowship, and in research and practice (particularly for faculty with responsibility for training the next generation). Such an approach must include opportunities for academic and experiential learning, both in research and in practice, and must be at a depth appropriate to the learner's intellectual stage and level of interest in population health. Before medical school, we should expose college students, and even those in high school or younger, to public health or population health concepts as argued by Riegelman and Garr.[26] Young students who are systems thinkers, especially those who are scientifically inclined and/or socially minded, might then consider a career in medicine and public health. We also need to reinforce population health principles and approaches not only during medical school, but also in graduate and postgraduate medical education. We must ensure that this knowledge and these skills are developed and enhanced in developing physicians through application during residency and fellowship. Without faculty to oversee the reinforcement of population health approaches and to serve as role models, population health principles are unlikely to become inherent to the role of a physician.[10]

Relevant CDC Activities

To help educate potential and current physicians (as well as future, informed citizens) about population health topics, and to recruit doctors and others into public health careers, the CDC has developed a multitude of programs and resources (see Appendix 1) for students and physicians of all ages—from elementary school pupils who are just becoming aware of the world around them to physicians who have been practicing for many years.

Target audience: Elementary and secondary school students

CDC scientists have collaborated with the education community to develop teaching tools, such as Excellence in Curriculum Integration through Teaching Epidemiology (EXCITE) (http://www.cdc.gov/excite) and the Science Ambassador Program for teachers (http://www.cdc.gov/excite/ScienceAmbassador/Science Ambassador.htm), to help educate the precollege audience. EXCITE is a Web-based resource that targets students, educators, and the general public, providing introductory epidemiology curriculum and reference materials, including practical case-study activities. The Science Ambassador Program is a teacher development program that introduces epidemiology and public health to middle and high school teachers who have an opportunity to develop new modules at CDC in collaboration with CDC scientists. By using epidemiologic principles, these instructional modules illustrate math and science concepts and methods through real-life case studies and exercises. They enable teachers to provide their students with quantitative evaluation and reasoning skills to interpret risks, engage in comparative reasoning, and make lifestyle choices. In addition, the modules provide students with examples of different career paths in public health and links to other Internet-based resources. These materials have been disseminated widely and used successfully in multiple settings for K–12 education.[27]

Further, since 1999, the National Science Olympiad has included a Disease Detectives competition (one of 34 events) in state and national contests (http://www.soinc.org/events/diseasedet/index.htm). These tournaments are rigorous, academic, interscholastic competitions that comprise a series of individual and team events for which students prepare during the entire academic year. Each year, more than 20,000 students from grades 7 through 12, representing over 5,000 schools, participate from all 50 states and Ontario, Canada. This event, sponsored by CDC, presents students with a disease outbreak or other public health problem (e.g., injuries, tobacco use). The students use the data presented to evaluate risks, hypothesize about etiology, and design appropriate control or intervention measures. Each year, the winning students, selected by CDC epidemiologists who designed the event, come to CDC to meet the CDC director and program staff who are involved in the same area of research in which the students competed. CDC staff also participate as judges in a similar competition for high school students, the Young Epidemiology Scholars competition, sponsored by the Robert Wood Johnson Foundation and the College Board (http://www.collegeboard.com/yes).

Target audience: College and university undergraduate students

Recently, CDC has become active in the national effort to bring the principles of epidemiology and public health to undergraduates, an effort begun primarily in undergraduate schools affiliated with schools of public health.[26] Public health in the undergraduate curriculum offers multiple advantages to undergraduate education: awareness of population health activities; a broad science education that is valued by medical and graduate schools; a context for interdisciplinary undergraduate education that brings together the humanities, social sciences, and sciences; a foundation for postgraduate study in different fields (e.g., business, law, and international affairs); and preparation for immediate careers in local public health, health information systems, or human services.[28] Excellent teaching resources suitable for the undergraduate level have been published.[29]

A report on a 2006 consensus conference on undergraduate public health education offers specific

recommendations for providing introductory public health curricula in all colleges and universities, including those without schools or programs in public health.[30] Participants, including CDC representatives, recommend that two introductory courses, Public Health 101 and Epidemiology 101, be offered by all U.S. colleges and universities to fulfill undergraduate social science and science distribution requirements. The full recommendations from the conference and sample curricular frameworks for the two courses are available online (http://www.teachpublichealth.org).

Because it is critically important to supplement academic learning with experience working in public health, CDC offers a small number of science internships, with small stipends, to minority college (as well as high school) students (http://www.cdc.gov/omhd/training.htm). Students spend a summer participating in research activities in various programs across the agency. Often, for these programs, CDC works with organizations interested in increasing the number of minorities choosing careers in public health or the health sciences—such as the Minority Health Professions Foundation or Morehouse College.

Target audience: Medical students

CDC manages far-reaching programs that introduce medical students to the population health perspective through real-life public health work, most frequently in applied epidemiology.

The CDC Experience, a one-year fellowship in applied epidemiology for rising third- or fourth-year medical students, is the newest of CDC's student programs, and one with the greatest opportunity to have a lasting impact on its participants (http://www.cdcfoundation.org/thecdcexperience). The explicit goal of this fellowship, supported by Pfizer's Public Health Group through the CDC Foundation, is the development of a population health perspective among physicians. The program has a rigorous, competency-based curriculum that balances applied, on-the-job learning experiences with more traditional, didactic ones. Each of the eight competitively selected fellows participates in public health surveillance activities and a field experience, finishes an analytic epidemiology project, writes a scientific manuscript, and delivers an oral scientific presentation. They have worked in a range of CDC program areas, including those targeted at preventing cardiovascular disease, birth defects, injuries, asthma, food-borne disease, tuberculosis (TB), and influenza. They have participated in outbreak investigations of TB, drug-resistant *Staphylococcus aureus*, leptospirosis, shigellosis, and other acute problems. Through their work at CDC, the first 24 graduates have already completed six first-authored and six coauthored *Morbidity and Mortality Weekly Report* (*MMWR*) articles; four first-authored, peer-reviewed publications; and numerous abstracts, posters, and presentations at scientific meetings. The fellows report an increase in critical-thinking and research skills and an enhanced understanding of their role as physicians within the larger context of public health and community health systems. A program objective is for participants to reach out to population-health-oriented faculty members at their respective medical schools to facilitate retention of this perspective on their return to school.

Since 1972, CDC has offered a six- to eight-week epidemiology elective for senior medical and veterinary students, with 50 to 70 students participating annually (http://www.cdc.gov/eis/applyeis/elective.htm). Whereas certain students are actively exploring a career in public health, others are merely interested in learning about public health or are drawn by the exciting possibility of participating in an outbreak investigation.[31,32] Elective students receive no stipend, but they do receive reimbursement from CDC for travel expenses associated with these outbreak investigations.

Medical students interested in global health have participated in the O.C. Hubert Student Fellowship in International Health since 1998 (http://www.cdcfoundation.org/fellowships/ochubert/index.aspx). Funded through the CDC Foundation, Hubert Fellows receive a minor stipend and spend 4 to 12 weeks with CDC staff in a developing country such as Thailand, Tanzania, or Peru working on priority health problems, including acute pneumonia, malaria, and food-borne disease.

The CDC-funded Hispanic-Serving Health Professions Schools, Inc. (HSHPS) Summer Internship Program (http://www.studentinternshipprogram.com) and the Ferguson Emerging Infectious Disease Fellowship Program (http://www.cdc.gov/ncidod/omwh/ferguson.htm) also provide public health opportunities to a limited number of minority medical students (and, in the case of Ferguson, other health professional students as well). Both these programs provide a stipend and cover housing and travel costs to and from CDC for the summer. Students in the HSHPS program work on health disparities in a disease area of interest, whether infectious or noninfectious in origin, whereas the Ferguson fellows conduct laboratory research on an infectious disease during their summer. The Minority Health Professions Foundation is also a key partner in administering the Ferguson Fellowship.

To improve population and public health education for a larger number of medical students, CDC partnered with the Association of American Medical Colleges (AAMC) in 2003 to establish the Regional Medicine–Public Health Education Centers at multiple medical schools. These medical schools partner with local or state health departments to integrate population health into their curricula for all medical students (http://www.aamc.org/members/cdc/aamcbased/regionalcenters.htm). Specific programs are described in this issue of *Academic Medicine*.[17–25]

Target audience: Residents and other early postgraduates

CDC offers higher-level programs for which physicians—often in the middle of, or just finishing, residency—are eligible. These programs comprise either short electives or longer-term experiential fellowships in such areas as epidemiology, public health informatics, prevention effectiveness, and laboratory science (http://www.cdc.gov/phtrain and http://www.aptm.org).

Epidemic Intelligence Service. The oldest and most prestigious program for residents and other postgraduates, with approximately 3,000 graduates, is the Epidemic Intelligence Service (EIS) (http://www.cdc.gov/eis), which was established in 1951 in response to concerns regarding the threat of biologic terrorism and the related shortage of epidemiologists who were trained to respond to such threats.[33] EIS, a combined training and service program

in the public health practice of epidemiology, was modeled after medical residency—learning applied epidemiology by doing real-world work. After a short, three-and-a-half-week foundational course in applied epidemiology, EIS officers are assigned to CDC headquarters programs, to field positions in state and local health departments, or, in the program's early years, to universities. In all of these assignments, officers conduct special studies in epidemiology, participate in public health surveillance, and are available to respond to epidemic threats, including threats of biologic or chemical terrorism.

Physicians, most often those trained in family medicine, internal medicine, pediatrics, and preventive medicine, continue to compose the majority of the participants in the EIS program. Thus, the EIS program has produced a steady stream of physicians trained in applied epidemiology, a substantial fraction of whom remain employed with CDC on graduation from the program.[34] Historically, many of our physician alumni have returned to clinical medicine, with great impact, for example, on the development of hospital and clinical epidemiology.[35] At least one EIS graduate helped to found the Society for Health Care Epidemiology of America in 1980 (William Scheckler, MD, personal communication, 2005); further, 12 of this society's presidents between 1980 and 1995 were EIS graduates.[35] Although the initial impetus was, and a continuing goal for the EIS program is, to develop public health epidemiologists, we do not consider physicians who return to clinical medicine to be failures of our program. Rather than losing them to the health care system, we have frequently gained advocates and critical partners in improving individual and community health. For example, clinicians who are EIS alumni are often those interested in the root causes of problems and are the first to call the health department regarding potential urgent threats to the public's health. In describing their careers for a book on the history of EIS, clinical alumni relate how the EIS has helped to define their career paths, providing them with quantitative skills and a population perspective that they have integrated into their roles in managed-care quality improvement, community health, and clinical research (Mark Pendergrast, personal communication, 2007).

Preventive medicine residency. CDC also offers a preventive medicine residency (PMR), accredited by the Accreditation Committee for Graduate Medical Education (ACGME), primarily to EIS graduates, preparing them for future leadership roles in public health and preventive medicine (http://www.cdc.gov/epo/dapht/pmr/pmr.htm). Our focus differs from residencies that are more clinical[36] or that offer shorter (2- to 3-month) rotations. CDC preventive medicine residents have a strong background in applied epidemiology (as a prerequisite, they must participate in the EIS program or go through an equivalent experience), and the majority have already completed a residency. They work in a public health setting for their entire practicum year, and if they have worked at the federal level in public health, they are required to move to a position with a state or local health department, and vice versa. Given the emphasis on leadership, residents must complete a project in each of the following five areas: community intervention, policy analysis and development, program evaluation, project management, and grant preparation and evaluation. Graduates have assumed leadership or supervisory roles in either public health and hospital infection control or medical quality improvement on completion of the program.

Target audience: Practicing clinicians

CDC does not have a centralized training activity targeted at practicing physicians; however, CDC does supply or fund a substantial number of educational resources for clinicians; some resources are geared toward clinicians at medical schools, but the majority are intended for practicing health care providers (see http://www.cdc.gov/CDCForYou/healthcare_providers.html). CDC provides links at this site to various guidelines (e.g., for treatment of sexually transmitted diseases, health-care-associated infections, or antibiotic-resistance infections; and for prevention of illnesses associated with international travel [the "Yellow Book": CDC Health Information for International Travel 2008]). Other resources available to practicing clinicians (as well as to the general public) are the CDC *MMWR Recommendations and Reports*, which contain prevention and treatment guidelines for a variety of diseases and injuries, usually in conjunction with free continuing medical education (CME), continuing nursing education (CNE), or other credits (http://www.cdc.gov/mmwr/cme/conted.html).

CDC educational materials are not limited to printed matter. For example, in the subject area of vaccine-preventable diseases, CDC offers guidelines for vaccination through curricular modules, satellite broadcasts, online conferences, podcasts, and self-study units that include CME, CNE, or other credits (http://www.cdc.gov/vaccines/ed/default.htm). In another example, the home page for CDC's Division of Tuberculosis Elimination contains links to many educational resources, including a link to four TB Regional Training and Medical Consultation Centers (RTMCC) funded by that division (http://www.cdc.gov/tb/rtmcc.htm). The RTMCCs, regionally assigned to cover all 50 states and the U.S. territories, provide training and technical assistance to increase human resource development in TB programs, develop TB educational materials, and provide medical consultation to medical providers and TB program directors (in health departments). Similar programs exist for other subject areas. In addition, CDC sponsors or cosponsors educational conferences for which physicians and other health professionals are a key audience (e.g., on combating diabetes and obesity [http://www.cdc.gov/diabetes/conferences/conf2006/index.htm], promoting recommended antibiotic use [http://www.cdc.gov/drugresistance/community/conferences.htm], or improving community readiness for pandemic influenza [http://www.ama-assn.org/ama/pub/category/17,239.html]).

Target audience: Faculty and institutions

CDC also supports the development of public health research skills among young physicians and other scientists and new public health research activities of young and established faculty (http://www.cdc.gov/od/science/PHResearch/grants/HPRI.pdf). As part of CDC's 2004 Health Protection Research Initiative, CDC awarded graduate training program grants to institutions of higher education (T01 grants) to support a continuing supply of well-trained scientists prepared

to lead and conduct cutting-edge public health research; these grants have recently been extended another two years. As another key component of this initiative, CDC also funded mentored research scientist development awards (K01 grants). These awards were intended to support career-development experiences, such as researching hepatitis B and liver cancer prevention methods or cardiovascular disease outcomes and trends among the elderly, which lead to independent research and substantially expand the knowledge and capabilities of research scientists. CDC's Health Protection Research Initiative has also funded centers of excellence in health marketing and health communication (P01 grants), in public health informatics (P01 grants), and in health promotion economics (P30 grants), as well as investigator-initiated research in worksite health promotion (R01 grants). Many recipients of these grants or participants in these training programs are physicians.

CDC has long supported multidisciplinary prevention research centers (PRCs), which emphasize engagement with the community and include a training component (http://www.cdc.gov/prc). A network of academic researchers, public health agencies, and community members, these PRCs build research teams of multidisciplinary faculty, conduct research projects on health- or population-specific issues (e.g., community interventions to decrease the health effects of diabetes or to prevent childhood obesity), create research networks for priority health issues (e.g., healthy aging and cancer prevention and control), seek outcomes applicable to public health program and policies, and build long-term relationships for engaging communities as partners in research.

CDC has research agendas and funds research in a variety of other specific areas (http://www.cdc.gov/od/science/PHResearch), often linking research support with support of training (e.g., the National Institute of Occupational Safety and Health's Education and Research Centers [http://www.cdc.gov/niosh/oep/training.html#erc], which support academic degree programs and research training opportunities, especially in occupational medicine). Other current CDC research funding opportunities are listed at (http://www.cdc.gov/od/science/PHResearch/funding.htm).

Future Directions

The 2007 IOM report, *Training Physicians for Public Health Careers*, recommends the development of more postgraduate fellowships in public health.[3] Those of us in public health certainly agree that, as mentioned in the report, more public health physicians are needed (the report estimates a gap of 10,000 physicians). We also strongly recommend that more physicians practice with a population health perspective. What is needed is not limited simply to population health education for all medical students or more physicians going into public health, but more physicians who are fully trained to use those population health skills to improve health in an integrated fashion, throughout their careers.

In fact, new models for residency are being considered or developed.[37] Certain preventive medicine specialists are concerned that they need to add more clinical time to the preventive medicine residency (in part for financial viability), and ACGME is asking whether more uniform clinical standards are needed for these residencies. Others have pointed out that perhaps preventive medicine is distinct from public health, and perhaps the training should be different.[38] However, given that most health care is delivered in ambulatory settings, directors of medical schools and primary care residencies—particularly the latter—are moving an increasing fraction of educational activities from the hospital setting to the community.[37,39] The American Academy of Pediatrics recognized community pediatrics as a key component of pediatrics,[40] and certain programs have implemented training to support this concept.[41–42] We are particularly intrigued with the models exemplified by the newly redesigned Duke family medicine residency (http://dukefamilymedresidency.mc.duke.edu) and the long-standing Albert Einstein College of Medicine Residency Program in Social Medicine (http://www.aecom.yu.edu/dfsm/page.aspx?id=447), both of which integrate elements of clinical medicine and community health and systematically commit to a mission of improving the health of the community.[43–45]

We who work in population health strongly support these models where the population health perspective is integrated fully with clinical medicine at the residency–fellowship–practice level (although the balance of traditional clinical medicine and population health approaches might be different in a family medicine residency versus a preventive medicine residency). Such professionals focus on protecting the health of their patients, not just caring for them after they become ill. They seek to understand the root causes of illness in the larger ecologic context, and they take systems-based action to prevent illness among the community of patients or potential patients. Such physicians should be skilled in, for example,

- identification of life-stage and environmental or occupational risks to optimal health,
- risk assessment (e.g., epidemiology and biostatistics),
- risk communication,
- individual and family behavior-modification sciences,
- safety, and
- fitness and nutrition.

In emphasizing health, we focus on what matters most and create a context for a reimbursement model that supports providers engaging in these areas. This model might contribute to adequate funding for preventive medicine residencies, a key mechanism for training physicians in population health concepts. CDC is again partnering with the AAMC to support integration of population health, this time into graduate medical education, with some seed funds for eligible primary care residencies (http://www.aamc.org/members/cdc/callforproposal07.pdf).

In fact, to broaden CDC's impact, perhaps the CDC fellowship programs need to engage more with the clinical world. Some of our physician EIS graduates have expressed concern regarding losing their connection to clinical medicine if they remain fully immersed in public health. They desire a career path that integrates their population health perspective and clinical medicine; recently, several explained that they did not apply to CDC's PMR because they wanted a more clinical connection than our program offers (Denise Koo, MD, personal communication, 2007). Just as certain primary care residencies

(mentioned previously) are integrating more community health or population health into their training, perhaps we, too, should consider either implementing a community intervention in partnership with a university medical center or offering more opportunities to our physician trainees, whether EIS officers or PMRs, to apply their population health skills (e.g., analysis of patterns and causes of illness) in a clinical environment (e.g., in an academic health center or across a health maintenance organization [HMO]). This will allow interested trainees to practice in both worlds, and it will attract even more applicants interested in functioning in such dual roles. The interdisciplinary nature of public health and the team skills learned will serve them well, regardless of career path. Faculty for such EIS or PMR assignments might be appointed jointly to the medical school and the health department, a model currently followed in at least two medical schools: Northeastern Ohio Universities College of Medicine, and the State University of New York Upstate Medical University.

To achieve this vision of multipronged population health education throughout undergraduate, graduate, and postgraduate medical education, CDC and its public health partners should also collaborate with interested medical school faculty and other relevant medical organizations. Faculty who integrate population health into their practice can both teach and serve as role models to reinforce population health principles, a key to the success of this vision. We in the public health community will need to make an investment in faculty development through short courses or sabbaticals in public health; likewise, public health professionals will need to spend more time in clinical settings. We must also invest substantially in faculty development grants, including those that support curriculum development and the training of teachers of population health. Perhaps initial pilots can be facilitated by senior CDC field-based staff; for example, Career Epidemiology Field Officers (CEFOs) or Quarantine Medical Officers could work with schools that have faculty with strong interests and skills in population health. CDC CEFOs are assigned around the country to state and local health departments to increase epidemiologic capacity and public health preparedness. CDC Quarantine Officers are assigned to strategic ports of entry into the United States and work with local health agencies and medical communities to prevent the introduction of, or further spread of, communicable diseases from outside the country into the United States. These CDC staff might teach in medical schools or residencies, attend clinical rounds and provide a population perspective, or even develop community health interventions in collaboration with a local medical school, supervising medical student or resident participation in such activities. In addition to providing service to the community, such activities can provide experiential learning opportunities to complement the didactic learning and enhance, through practice, integration of population health into the role and identity of future physicians.

Population Health Physicians and the Health System

Public health and community medicine physicians are trained to treat populations just as the clinician is trained to treat individual patients and, to a certain degree, their families. The physician or health care professional with a population health perspective addresses influences outside the health system (e.g., poverty, climate change, and globalization) as challenges in the same way that a clinician addresses a patient's personal risk factors at home or work. Health risks that challenge clinicians (e.g., motor vehicle crashes, tobacco use, environmental exposures, risky sexual behaviors, or obesity) often are addressed more effectively on a population level, often through environmental change.[46] Today, possibly even more than in the past, we need physicians who understand and appreciate the importance of the population perspective of health and who can care for the person as well as the community; such physicians take action and effect systems change that will improve the health of the individual patient and the community. Physicians with an integrated educational background and experience in facilitating health have a deep understanding of the continuum between medicine and public health. They work in different settings—public health, government policy, academic medicine, HMOs, community health systems, and community-based organizations—to improve the health of the population. They are well positioned to serve as boundary spanners, leaders, and agents of change vital for healing the long-standing and costly schism between medicine and public health.[8] Such systems thinkers are essential for tackling the health system problems of today—lack of quality assurance, inefficiencies, inequities, ineffectiveness, etc.—as well as urgent health issues that are perhaps best addressed by solutions outside the health system. CDC is a critical partner in this effort to improve the health of the public.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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Appendix

Selected Centers for Disease Control and Prevention (CDC) Activities in the Area of Population Health and Medical Education, 2008*

Target audience	Name and/or description of content	URL
Elementary and high school students	Excellence in Curriculum Integration through Teaching Epidemiology Program—Teaching tools and resource links	(www.cdc.gov/excite)
	Science Ambassador Program—Opportunities for teachers to develop lesson plans with CDC staff	(http://www.cdc.gov/excite/ScienceAmbassador/ScienceAmbassador.htm)
High school students	National Science Olympiad competition: Disease Detectives—Event resources for supervisors, coaches, competitors	(www.soinc.org/events/diseasedet/index.htm)
	CDC/Emory Disease Detective Camp—Information about one-week academic summer day camp for high school juniors and seniors	(http://www.cdc.gov/gcc/exhibit/camp.htm)
	Young Epidemiology Scholars competition†—Information about scholarship competition for high school juniors and seniors and resources for teaching epidemiology	(www.collegeboard.com/yes)
High school and college students	Office of Minority Health and Health Disparities Training Opportunities—Information about science internships for minority students	(www.cdc.gov/omhd/training.htm)
College students	Undergraduate Education in Public Health—Teaching tools, including curricular frameworks for Public Health 101, Epidemiology 101, and Global Health 101	(www.teachpublichealth.org)
Rising third- and fourth-year medical students	*The CDC Experience*: Applied Epidemiology Fellowship—General, application, and alumni information about the one-year program at CDC	(www.cdcfoundation.org/thecdcexperience)
Third- and fourth-year medical and veterinary students	Epidemiology Elective Program for Senior Medical and Veterinary Students—General and application information about the six- to eight-week epidemiology elective at CDC	(www.cdc.gov/eis/applyeis/elective.htm)
	O.C. Hubert Student Fellowship in International Health—Information about the two- to three-month overseas experience with CDC staff	(www.cdcfoundation.org/fellowships/ochubert/index.aspx)
Minority medical and other health professional students	Ferguson Emerging Infectious Disease Fellowship Program—Information on the emerging infectious disease fellowship, an eight-week summer laboratory research program	(www.cdc.gov/ncidod/omwh/ferguson.htm)
Medical students	Hispanic-Serving Health Professions Schools (HSHPS)—Information about the eight-week, summer internship program that focuses on health disparities	(http://www.studentinternshipprogram.com/)
	Regional Medicine–Public Health Education Centers (Regional Centers to Improve Medical Students' Exposure to Public Health and Population Medicine)—Information on activities of each of the medical schools funded by AAMC and CDC to integrate population health into their curricula	(http://www.aamc.org/members/cdc/aamcbased/regionalcenters.htm)
Medical and allied health students	Fetal Alcohol Spectrum Disorders (FASD) Regional Training Centers—Description and links to centers developing and implementing educational curricula regarding FASD prevention, identification, and care	(http://www.cdc.gov/ncbddd/fas/regional.htm)
Residents and early postgraduates	CDC Public Health Training Opportunities—Information about fellowships in various areas of public health	(www.cdc.gov/phtrain)
	Association for Prevention Teaching and Research—General information, including information about fellowships and training opportunities	(www.atpm.org)
	Epidemic Intelligence Service—Information about the two-year applied epidemiology fellowship at CDC or in state and local health departments	(www.cdc.gov/eis)
	Preventive Medicine Residency (PMR) and Preventive Medicine Fellowship (PMF)—Information about the one-year practicum at CDC or in state and local health departments	(www.cdc.gov/epo/dapht/pmr/pmr.htm)
	Public Health Informatics Fellowship Program (PHIFP) at CDC—Information about the two-year, CDC-based fellowship	(www.cdc.gov/epo/phifp)

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Target audience	Name and/or description of content	URL
	Steven M. Teutsch Post-Doctoral Fellowship in Prevention Effectiveness Methods—General and application information about the two-year fellowship at CDC	(www.cdc.gov/epo/fellow.htm)
	Emerging Infectious Diseases Laboratory Fellowship—Information about the two-year, emerging infectious diseases fellowship in local, state, or federal public health laboratories	(http://www.aphl.org/training_and_fellowships/fellowships/Pages/default.aspx)
Postgraduates	National Academies of Science—NIOSH Post-Masters and Post-Doctoral Research Associateship Program—Information for a one-year (with option to renew) occupational health research associateship at the offices of the National Institute for Occupational Safety and Health	(http://www.cdc.gov/niosh/employ/academies.html)
Practicing clinicians	CDC for Healthcare Providers—Clinical guidelines on a variety of health-related topics	(www.cdc.gov/CDCForYou/healthcare providers.html)
	Morbidity and Mortality Weekly Report—Information, breaking public health news, and continuing education credits on a variety of topics	(www.cdc.gov/mmwr/cme/conted.html)
	Vaccines and Immunizations—Information on vaccine-preventable diseases and vaccine policies and recommendations	(http://www.cdc.gov/vaccines/default.htm)
	Regional Training and Medical Consultation Centers (RTMCCs)—Information on tuberculosis, specifically training and technical assistance, educational materials, and medical consultation	(www.cdc.gov/tb/rtmcc.htm)
	National Network of STD/HIV Prevention Training Centers—Training and curricular materials on sexually transmitted diseases and HIV	(http://depts.washington.edu/nnptc)
	Self-Study STD Modules for Clinicians—Seven educational modules on specific STD topics	(http://www2a.cdc.gov/stdtraining/self-study/default.asp)
	33rd 10-Day Seminar on the Epidemiology and Prevention of Cardiovascular Disease—Information on the intensive introduction to the epidemiology and prevention of major cardiovascular diseases for qualified health professionals planning careers in research, teaching or practice in this area	(http://www.americanheart.org/presenter.jhtml?identifier=3043315)
	Fetal Alcohol Spectrum Disorders: Regional Training Centers—Description and links to centers developing and implementing educational curricula regarding FASD prevention, identification, and care	(http://www.cdc.gov/ncbddd/fas/regional.htm)
	Information on conferences focused on various areas of population health (content/focus may change each year)	(www.cdc.gov/diabetes/conferences/conf2006/index.htm) (www.cdc.gov/drugresistance/community/conferences.htm) (www.ama-assn.org/ama/pub/category/17239.html) (www.cdc.gov/stdconference) (www.cdc.gov/reproductivehealth/MCHEpi/2007/AboutConference.htm)
Practicing clinicians, medical examiners, coroners	National Center for Health Statistics—Training and education in certifying cause of death	(www.cdc.gov/nchs/about/major/dvs/handbk.htm)
Faculty, institutions	General information on research and training grants supporting public health research and development of public health research skills	(www.cdc.gov/od/science/PHResearch/grants/HPRI.pdf) (www.cdc.gov/od/science/PHResearch/) (www.cdc.gov/od/science/PHResearch/funding.htm) (grants.nih.gov/grants/guide/pa-files/PAR-07–231.html)
	Training Programs—Research and training grants related to occupational health	(www.cdc.gov/niosh/oep/training.html#erc)
	Prevention Research Centers—Information on training grants and a network of academic researchers, public health agencies, and community members that conducts applied research in disease prevention and control	(www.cdc.gov/prc)
	Ready-to-Use STD Curriculum for Clinical Educators—Comprehensive curricular materials on seven different STD topics	(http://www2a.cdc.gov/stdtraining/ready-to-use)

* For additional information regarding other potentially relevant activities, see (www.cdc.gov).
† Supported by the Robert Wood Johnson Foundation. CDC staff participate as judges in the competition.