

# Applied Epidemiology Competencies for Governmental Public Health Agencies: Mapping Current Curriculum and the Development of New Curriculum

LOUISE-ANNE McNUTT, PhD<sup>a</sup>  
SYLVIA E. FURNER, MPH, PhD<sup>b</sup>  
MICHAEL MOSER, MD, MPH,  
FACPM<sup>c</sup>  
ELIZABETH MCGEAN WEIST, MA,  
MPH<sup>d</sup>

As discussed in this issue, the Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists (CSTE) recently developed Competencies for Applied Epidemiologists in Governmental Public Health Agencies (AECs).<sup>1,2</sup> These detailed practice competencies are designed to provide guidance about knowledge and skills useful for a range of applied epidemiology positions, from entry-level (Tier 1), to mid-level (Tier 2), to senior epidemiology management (Tier 3a), and scientific positions (Tier 3b), with a goal of building epidemiology workforce capacity.

Upon completion of the AECs, officials at CDC and leadership at the Association of Schools of Public Health (ASPH) initiated a series of discussions in 2006 to explore how the practice competencies were being used in the schools of public health (SPHs). The discussants agreed to contact ASPH's Epidemiology and Biostatistics Council to identify members who would be willing to develop a bridge between the Tier 1 AECs and the epidemiology components of Master of Public Health (MPH) and Master of Science (MS) curricula, with the understanding that some new curricula might need to be developed to fill possible identified gaps.

With support from CSTE leadership, ASPH consequently agreed to create a task force for this initiative called the ASPH/CDC/Epidemiology and Biostatistics Council Applied Epidemiology Competencies Task Force. The Task Force is in the process of mapping Tier 1 competencies to existing curricula at several SPHs, developing a model curriculum for applied epidemiology competency development, where gaps exist, and producing guidelines and examples for how SPHs may develop practica/rotations that map to some of the more applied competencies.

The ASPH Task Force benefits from membership of epidemiologists from diverse academic institutions with varied expertise: Sylvia Furner, University of Illinois at Chicago (UIC) School of Public Health and Chair of the Task Force; James Gale of the University of Washington School of Public Health

<sup>a</sup>School of Public Health, University of Albany, State University of New York, Albany, NY

<sup>b</sup>School of Public Health, University of Illinois at Chicago, Chicago, IL

<sup>c</sup>Akron Health Department, Akron, OH; Northeastern Ohio Universities College of Medicine, Rootstown, OH

<sup>d</sup>Association of Schools of Public Health, Washington, DC

Address correspondence to: Sylvia E. Furner, MPH, PhD, University of Illinois at Chicago School of Public Health, 1603 W. Taylor, Room 1145, Chicago, IL 60612; tel. 312-996-5013; fax 312-996-1374; e-mail <sefurner@uic.edu>.

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and Community Medicine; Louise-Anne McNutt of the State University of New York at Albany School of Public Health; Kathleen Miner of the Emory Rollins School of Public Health; Michael Moser of the Akron Health Department; and Arthur Reingold of the University of California at Berkeley School of Public Health.

This initiative is timely as ASPH recently completed the development of a comprehensive list of MPH core competencies designed to serve as a resource or guide for the basic knowledge, skills, and characteristics expected for students graduating with an MPH degree.<sup>3</sup> The MPH core competencies are broad and foundational, with about 10 competencies in each core field of public health (i.e., epidemiology, biostatistics, health policy and management, social and behavioral sciences, environmental health sciences) and 70 other cross-cutting competencies representing integrated knowledge and skills (i.e., communication and informatics, diversity and culture, leadership, professionalism, program planning, public health biology, systems thinking) needed for effective public health practice. While the MPH core competencies guide the broad educational goals of an MPH curriculum, they are not designed to provide guidance for specialization areas. Developing a curriculum for a subspecialty such as applied epidemiology in a governmental public health agency is an opportunity to move applied epidemiology forward and provide an example of how the general MPH competencies and subspecialty competencies can be integrated into a master's-level curriculum.

As a general statement, the Tier 1 AECs are consistent with the skills of new MPH or MS trained graduates, provided these professionals have focused on applied epidemiology in their graduate education. However, a review of the CDC/CSTE Tier 1 AECs quickly highlights the multidisciplinary nature of applied epidemiology in the governmental public health setting, and makes it clear that curriculum mapping for an applied epidemiology track cannot be limited to epidemiology courses. The skills and knowledge needed for applied epidemiology practice in a governmental public health agency cross over to many ASPH MPH core competency domains besides epidemiology, such as biostatistics, health policy and management, communication, systems thinking, and diversity and culture. Figure 1 provides examples of several Tier 1 and ASPH MPH competencies that clearly overlap.

Current epidemiology programs in academic settings have considerable variation in focus areas available to students majoring in epidemiology. Only a small number of schools have developed a specific focus area related to public health practice in federal, state, and

local health departments. This programmatic diversity makes it challenging both to map AECs and to develop a model curriculum. This diversity has to be a critical factor for the Task Force to take into account. A key concept that the Task Force accepted from the beginning of its work is that every epidemiology program cannot—and should not—be strong in all areas.

The Task Force's initial attempt to map AECs to curricula in several academic epidemiology programs identified substantial variations of current coverage. In subsequent discussions, the Task Force considered these diverse findings and identified important issues that needed to be taken into account in the development of a model applied epidemiology curriculum.

First and foremost, it was agreed that no curriculum plan for a subspecialty area would be applicable to every SPH. Rather, it is expected that a range of educational opportunities would be available for students, with some SPH epidemiology programs providing curricula that substantially cover the Tier 1 competencies, and other programs providing an applied epidemiology curriculum limited to the overlap with ASPH MPH core competencies (e.g., infectious disease epidemiology).

Second, it seems unlikely that most MPH programs can develop a curriculum that completely assures the Tier 1 competency set, because some of the Tier 1 competencies require applied experience that can only be obtained during an extended period working in a public health agency. Extended field experiences for MPH students may offer a way around this barrier, but fitting such extended experiences into MPH curricula is challenging.

Third, the AECs may be developed through different courses depending on how the curriculum is organized at an SPH. For example, competencies related to outbreak investigation may be covered in a topic-specific course (e.g., an outbreak investigations course), in a module in a larger course (e.g., field investigations), or across several courses (e.g., introduction to epidemiology, infectious disease epidemiology, emergency preparedness). The Task Force decided to conduct its curriculum mapping and development process in light of these observations. This process is undertaken with the clear understanding that a subspecialty program for applied epidemiology in governmental public health agencies is not being recommended for every SPH. The Task Force recognizes the fact and value of educational diversity. Accordingly, the Task Force has agreed to focus on providing comprehensive guidance for SPHs that are interested in identifying themselves as programs specializing in applied epidemiology for governmental public health agencies. This guidance will include examples of curriculum mapping for

**Figure 1. Examples of ASPH MPH competencies and CDC/CSTE AECs with some overlap**

ASPH MPH competencies <sup>a</sup>	CDC/CSTE AECs—Tier 1	Overlap	Potential courses covering ASPH MPH competencies	Potential courses covering CDC/CSTE AECs
Calculate basic epidemiology measures (Epidemiology, C7)	<p>I. Skill domain—assessment and analysis</p> <p>F. Analyze data from an epidemiologic investigation or study</p> <p>2. Conduct analysis of data</p> <ol style="list-style-type: none"> <li>Compute frequencies and descriptive statistics</li> <li>Perform analyses for rates and age adjustment as directed</li> <li>Perform analyses for measures of association (e.g., relative risks and odds ratios), confidence intervals, and p-values</li> <li>Interpret measures of association, confidence intervals, and p-values</li> </ol>	Some	<p>Epidemiology 1</p> <p>Biostatistics 1</p> <p>Computer Programming 1 (e.g., SAS)</p>	<p>Epidemiology 1 and 2</p> <p>Biostatistics 1 and 2</p> <p>Computer Programming 1 (e.g., SAS, Stata)</p> <p>Additional quantitative methods course</p>
Comprehend basic ethical and legal principles pertaining to the collection, maintenance, use, and dissemination of epidemiologic data (Epidemiology, C5)	<p>I. Skill domain—assessment and analysis</p> <p>D. Apply principles of good ethical/legal practice as they relate to study design and data collection, dissemination, and use</p> <ol style="list-style-type: none"> <li>Follow ethics guidelines and principles when planning studies; conducting research; and collecting, disseminating, and using data <ol style="list-style-type: none"> <li>Collect and use public health data, including individual identifiers, only with clearly identified justification</li> <li>Balance respect for people and individual privacy with the risk of threat to the community</li> <li>Apply public health code of ethics collection, management, dissemination, and use of data and information, including principles of justice, timeliness, and transparency of purpose (<a href="http://www.apha.org/codeofethics">www.apha.org/codeofethics</a>)</li> </ol> </li> <li>Apply relevant laws to data collection, management, dissemination, and use of data and information</li> </ol>	Substantial	<p>Public Health 1</p> <p>Epidemiology 1</p> <p>Biostatistics 1</p> <p>Computer Programming 1</p> <p>Ethics 1</p>	<p>Public Health 1</p> <p>Epidemiology 1</p> <p>Biostatistics 1</p> <p>Computer Programming 1</p> <p>Ethics 1</p>
Identify key sources of data for epidemiologic purposes (Epidemiology, C1)	<p>I. Skill domain—assessment and analysis</p> <p>A. Recognize public health problems pertinent to the population</p> <ol style="list-style-type: none"> <li>Recognize the existence of a public health problem <ol style="list-style-type: none"> <li>List relevant data and information sources within and outside the public health system</li> </ol> </li> </ol>	Some	<p>Public Health 1</p> <p>Epidemiology 1</p>	<p>Public Health 1</p> <p>Epidemiology 1 and 2</p> <p>Infectious Diseases Epidemiology</p>
Explain how the contexts of gender, race, poverty, history, migration, and culture are important in the design of interventions within public health systems (Systems Thinking, L6)	<p>I. Skill domain—assessment and analysis</p> <p>H. Assist in developing recommended evidence-based interventions and control measures in response to epidemiologic findings</p> <ol style="list-style-type: none"> <li>Define cultural/social/political framework for recommended interventions <ol style="list-style-type: none"> <li>Describe study data in a way that makes clear the rationale for the recommendations</li> </ol> </li> </ol>	Some	<p>Behavioral Science 1</p> <p>Public Health 1</p> <p>Epidemiology 1</p>	<p>Behavioral Science 1</p> <p>Public Health 1</p> <p>Epidemiology 1 and 2</p>

continued on p. 16

**Figure 1 (continued). Examples of ASPH MPH competencies and CDC/CSTE AECs with some overlap**

ASPH MPH competencies	CDC/CSTE AECs—Tier 1	Overlap	Potential courses covering ASPH MPH competencies	Potential courses covering CDC/CSTE AECs
<p>Illustrate how changes in public health systems (including input, processes, and output) can be measured (Systems Thinking, L7)</p> <p>VII. Skill domain—leadership and systems thinking            C. Use performance measures to improve epidemiology program effectiveness            1. Contribute to implementation and monitoring of organizational performance measures that demonstrate program effectiveness            a. Demonstrate knowledge of performance measures            d. Adopt and implement performance measures            f. Take action to improve program performance</p>		Some	Behavioral Science 1 Public Health	Behavioral Science 1 Public Health Epidemiology 2 Surveillance
<p>Analyze determinants of health and disease using an ecological framework (Professionalism #6)</p> <p>Articulate how biological, chemical, and physical agents affect human health (Public Health Biology, I7)</p> <p>I. Skill domain—assessment and analysis            H. Assist in developing recommended evidence-based interventions and control measures in response to epidemiologic findings            1. Define cultural/social/political framework for recommended interventions            a. Describe study data in a way that makes clear the rationale for the recommendations            Apply understanding of human and environmental biology and behavioral sciences and principles to determine potential biological mechanisms of disease            II. Skill domain—basic public health sciences            A. Know how causes of disease affect epidemiologic practice            1. Relate basic etiologic processes for human diseases to subject matter areas of interest (e.g., infectious diseases, chronic diseases)            2. Apply understanding of human and environmental biology and behavioral sciences and principles to determine potential biological mechanisms of disease</p>		Some	Epidemiology 1 Human Biology	Epidemiology 1 and 2 Human Biology Infectious Disease Epidemiology
<p>Prepare a program budget with justification (Program Planning, K8)</p> <p>VI. Skill domain—financial and operational planning and management            B. Describe the financial planning and budgetary process of the epidemiology program            2. List resources necessary to carry out tasks in the operational plan, including personnel, equipment, supplies, and travel costs</p>		Substantial	Health Policy and Management	Health Policy and Management

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AECs = Competencies for Applied Epidemiologists in Governmental Public Health Agencies

\*Association of Schools of Public Health. Master's degree in public health core competency development project: version 2.3. Domains and competencies only, May 2007 [cited 2007 Jun 14]. Available from: URL: <http://www.asph.org/userfiles/WordFormat-DomainsandCompetenciesOnly.doc>

SPHs that do not currently have a curriculum track for applied epidemiology practice in governmental public health agencies.

The Tier 1 AECs are extensive and definitely merit consideration as the focus of an MPH track or graduate-level certificate for programs designed to prepare epidemiology students for careers in federal, state, and local health departments. Clearly, we need to build on the epidemiology curriculum that currently exists in SPHs and other academic epidemiology programs. Most epidemiology programs provide strong epidemiology methods and other quantitative methods training. Figure 1 provides examples of Tier 1 AECs that can be expected to be covered at most SPHs because they overlap with the ASPH MPH core competencies. However, four major Tier 1 competency areas have been identified that tend not to be currently covered in depth: (1) public health surveillance (Figure 2), (2) outbreak investigations, (3) community health assessment, and (4) local public health management for epidemiologists.

All accredited SPHs currently require applied fieldwork or internships. For students interested in applied epidemiology practice in a governmental public health agency, targeting the internship or fieldwork via placement in a federal, state, or local health department with a specific focus on development of the Tier 1 AECs is a logical step. It is also one that the Task Force feels will be necessary to allow these students to develop their skills in the applied “real” environment. Several SPHs have found that such placements have resulted in employment opportunities for students, thus serving as an important steppingstone for graduates starting their careers.

These are exciting times as the public health academic and practice communities work collaboratively

to build stronger and more relevant academic programs pertinent to applied public health and as SPHs continue to move toward more competency-based curricula. A national need to build the epidemiology workforce capacity in public health agencies has been identified. Now, a national set of AECs has been developed. The work of the Task Force discussed in this article is targeted at providing resources for SPHs that want to offer their students an opportunity to attain the Tier 1 AECs during their completion of an MPH degree.

The Task Force will continue to map competencies to current curricula for programs with substantial and partial convergence to the Tier 1 AECs. We hope that students interested in a career in federal, state, or local public health will choose these programs as the starting point for their specialized applied epidemiology training. In 2007, the Task Force proposed model recommendations for academic development of the CSTE/CDC AECs. This model can be used by SPHs to enhance an already existing applied epidemiology track or to develop a new specialization or track in applied epidemiology in governmental public health agencies.

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**Figure 2. Example of detailed CDC/CSTE Tier 1 AECs: surveillance**

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- I. Skill domain—assessment and analysis
    - B. Conduct surveillance activities
      - 2. Identify surveillance data needs
        - a. Create case definition(s) based on person, place, and time
        - g. Recognize potential uses of data to inform surveillance system
      - 3. Implement new or revise existing surveillance systems
        - a. Define objectives and uses of surveillance system
        - b. Test data collection, data storage, and analytical methods as directed
        - c. Assist in creating working surveillance system
        - d. Collect data for verification of the defined surveillance system parameters (e.g., timeliness, frequency)
        - e. Classify potential cases according to whether they meet the case definition
        - f. Interview people with illness to solicit necessary information
        - g. Assist in monitoring data quality
        - h. Maintain good working relationships with reporting entities
        - i. Provide feedback to reporting entities and other organizations or individuals who need to know about the data or system
      - 4. Report key findings from the surveillance system
        - a. Provide system results to senior epidemiologists
        - b. Recognize implications to public health programs
        - c. Assist in developing conclusions from the surveillance data
        - d. Communicate results to senior staff
      - 5. Support evaluation of surveillance systems
        - a. Collect data necessary for evaluation of surveillance systems using national guidance and methods
        - b. Assist in preparing recommendations for modifications to surveillance systems on the basis of evaluation
        - d. Assist in implementing changes to surveillance system on the basis of results of evaluation
    - E. Organize data from surveillance, investigations, or other sources
      - 1. Assist in definition of database requirements, if indicated
        - b. Adhere to national standards for coding and variables as directed (e.g., assigning numeric codes to text response options for a variable) to ensure accuracy and ease of analysis
        - c. Use data entry techniques that ensure accuracy and reliability
        - d. Conduct data entry validation
        - e. Perform data cleaning and error correction
      - 2. Maintain databases
        - a. Maintain original data
        - c. Follow established procedures for creating new variables as necessary to support analysis of data
        - e. Follow established procedures for linking relational data and subsetting them into analysis-specific flat datasets
        - g. Document all changes to database
        - h. Apply practices for secure (restricted access) and stable (routine backups, database redundancy) data storage
  - II. Skill domain—basic public health sciences
    - B. Identify the role of laboratory resources in epidemiologic activities
      - 1. Identify the roles and capabilities of public health laboratories and other laboratories and how they are used in epidemiologic investigations
      - 4. Use identified specimen collection, storage, and transportation measures
  - V. Skill domain—cultural competency
    - C. Describe surveillance systems that include groups subject to health disparities or other potentially underrepresented groups
      - 1. Identify standard categories special populations
      - 2. Identify historical, social, and political contexts of standard categories
      - 3. Identify limitations of standard categories
      - 7. Avoid potential adverse impacts of data collection on special populations
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