Executive Summary

The Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists (CSTE) developed the *Competencies for Applied Epidemiologists in Governmental Public Health Agencies* (Applied Epidemiology Competencies or AECs for short) to improve the practice of epidemiology within the public health system. The document

- Defines the discipline of applied epidemiology and
- Describes what skills four different levels of practicing epidemiologists working in government public health agencies should have to accomplish required tasks.

The AECs were developed within the framework of the Core Competencies for Public Health Professionals—a product of the Council on Linkages Between Academia and Public Health Practice—and thus are consistent with the larger field of public health practice. The AECs resulted from 2 years of highly collaborative work by an expert panel representing local, state, and federal public health agencies and schools and graduate programs of public health. Epidemiologists at all levels of public health practice from throughout the country and from academia provided substantial input into the AECs.

The target audience and intended uses of the AEC are as follows:

- Practitioners: to assess current skills, create career development plans, and plan specific training;
- Employers: to create career ladders for employees, develop position descriptions and job qualifications, develop training plans for employees, determine compensation, and assess epidemiologic capacity of the organization;
- Educators: to design programs that train the next generation of epidemiologists to meet the needs of public health agencies, incorporate critical elements of epidemiologic practice into existing coursework, and provide continuing education to the current workforce.

The document defines competencies for four tiers of practicing epidemiologists categorized on the basis of level of responsibility, experience, and education: entry-level or basic, mid-level, supervisory, and senior scientist/researcher. The expert panel intended that all persons practicing applied epidemiology gain minimal competency in all of the defined skill domains within the tier that most closely matches their level of responsibility. However, every applied epidemiologist is not expected to be equally competent in all areas. Different public health programs that use applied epidemiology may emphasize different competency areas, and a government agency's responsibilities, needs, and resources may require persons in individual epidemiologic positions to focus on particular competencies.

CDC and CSTE seek to generate awareness throughout the public health system of the availability of this new tool. We encourage individual epidemiologists, public health agencies, and academic centers to use the competencies and to move with us toward a common goal of improving epidemiologic practice. We will publish information about the competencies, including tools and documentation to support their use, on the CDC (www.cdc.gov/AppliedEpiCompetencies) and CSTE (www.cste.org/competencies.asp) Web sites.

Preface

Introduction

Epidemiology, one of the core sciences of public health, is "the study of the distribution and determinants of health-related states and events in specific populations, and the application of this study to control of health problems."[1] Epidemiologists produce data for decision-making and for understanding disease in the population. Public heath epidemiologists who work in local, state, and federal health agencies are critical for the detection, control, and prevention of major health problems.

The Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists (CSTE) recognize the vital role of applied epidemiologists working at all levels of government public health practice. However, recent studies demonstrated a significant shortage of epidemiologists needed by local and state public health agencies.[2,3,4].In addition, epidemiologists practicing in public health agencies often do not have sufficient training to carry out their responsibilities. In a CSTE survey,[2] 29% of epidemiologists had no formal training or academic coursework in epidemiology. The assessment indicated a need for additional training in several key areas, particularly design of epidemiologic studies, design of data-collection tools, data management, evaluation of public health interventions, and leadership and management.

In January 2004, CDC and CSTE hosted a summit to address issues affecting public health epidemiologists. Leaders in applied epidemiology were invited to discuss the key workforce issues. Participants strongly supported the need to establish core competencies for applied epidemiologists. This competency development process since has been identified as a priority for CDC and CSTE.

In October 2004, CDC and CSTE convened an expert panel to define applied epidemiology competencies (AECs) for local, state, and federal public health epidemiologists. This panel comprised representatives from state and local health agencies, schools of public health, and private industry and from throughout CDC (Appendix A). Led by experts in competency development, the panel worked through a structured process, which included ample opportunity for input from practicing and academic epidemiologists, to define the AECs (Appendix B).

[1] Last JM. *A Dictionary of Epidemiology*. 4th edition. New York: Oxford University Press, 2001:62.

[2] Council of State and Territorial Epidemiologists. *2004 National Assessment of Epidemiologic Capacity: Findings and Recommendations*. Atlanta: Council of State and Territorial Epidemiologists, 2004. Available at http://www.cste.org//Assessment/ECA/pdffiles/ECAfinal05.pdf. Accessed May 31, 2006.

[3] Association of State and Territorial Health Officials. *State Public Health Employee Worker Shortage Report: A Civil Service Recruitment and Retention Crisis*. Washington, DC: Association of State and Territorial Health Officials, 2004. Available at http://www.astho.org/pubs/Workforce-Survey-Report-2.pdf. Accessed May 31, 2006.

[4] Bureau of Health Professions, Health Resources and Services Administration. *Public Health Workforce Study*. Rockville, MD: U.S. Department of Health and Human Services, Health Resources and Services Administration, 2005. Available at http://bhpr.hrsa.gov/healthworkforce/reports/publichealth/default.htm. Accessed May 31, 2006.

Goal and Objectives

The goal of the AECs is to improve the practice of epidemiology in public health agencies. The objectives are to create a comprehensive list of competencies that

- Define the discipline of applied epidemiology and
- Describe what skills four different levels of practicing epidemiologists working in government public health agencies should have to accomplish required tasks.

Target Audience

The AECs focus on the knowledge, skills, and abilities needed to practice epidemiology in government public health agencies. The AECs target primarily persons who currently practice epidemiology and persons who seek to become epidemiologists in government public health agencies. However, many of the competencies apply to epidemiologists practicing in other venues, including research and private industry. In addition, many apply to people in public health agencies who use epidemiologic methods in their jobs—such as public health nurses and environmental health specialists—but who do not classify themselves as epidemiologists. Any person, regardless of job title, should meet the recommended level of competency for any tasks he or she performs that require epidemiologic methods.

Framework

Definition of competencies

Competencies are action-oriented statements that delineate the essential knowledge, skills, and abilities in the performance of work responsibilities.[5] Competencies are describable and observable.

Guiding principles for AECs

- Base them on the Core Competencies of the Council on Linkages for Core Competencies for Public Health Professionals.
  The AECs were created within the framework of the Core Competencies for Public Health Professionals, developed by the Council on Linkages Between Academia and Public Health Practice (COL).[6] The COL framework defines eight skill domains that encompass the entire field of public health practice. By incorporating the AECs into the eight skill domains of the COL, the expert panel recognized the practice of epidemiology as a subfield of public health and acknowledged that people practicing epidemiology in a public health setting should develop competency as public health practitioners.

- Seek broad input.
  The expert panel solicited input from the local, state, and federal practitioners and from schools of public health to ensure the AECs truly reflected the practice of epidemiology in public health agencies and could be used in the practice setting and in schools of public health. Furthermore, the broad input process provided a mechanism for educating individual epidemiologists, public health agencies, academic centers, and professional organizations about the AECs.

[5] Nelson JC. Essien JDK., Loudermilk R. Cohen D. *The Public Health Competency Handbook: Optimizing Individual & Organization Performance for the Public's Health*. Atlanta, GA: Center for Public Health Practice of the Rollins School of Public Health, 2002.

[6] Public Health Foundation. Council on Linkages Between Academia and Public Health Practice. Available at http://www.phf.org/Link.htm. Accessed May 31, 2006.

- Create a broad scope of competencies.
  The expert panel intentionally created broad competencies that would cover the discipline of applied epidemiology, which itself is broad and diverse. CDC and CSTE intend that all persons practicing applied epidemiology—including persons who may not have the title of epidemiologist but whose job requires the use of epidemiologic methods—gain minimal competency in all of the defined skill domains. However, every applied epidemiologist is not expected to be equally competent in all areas. Different content areas of applied epidemiology (e.g., infectious disease, chronic disease, environmental health) may emphasize different competency areas. In addition, job descriptions among public health agencies vary by the needs and resources of the agency, the setting (rural or urban), and the scope of the agency's responsibilities (local, state, or federal).

- Guide careers in applied epidemiology.
  The competencies represent a continuum of applied epidemiologic practice, not a single point in time in a person's career. In other words, a person may not start with knowledge and skills in all areas but would be expected to gain knowledge within each tier and potentially move through tiers over time.

Structure of the AECs

- Identification of tiers of epidemiologic practice.
  During development of the AECs, the expert panel recognized that people practicing epidemiology represent a broad range of experience, knowledge, and job responsibilities for which no one set of competencies would be appropriate. Therefore, the panel defined four tiers of epidemiologic practice differentiated on the basis of level of responsibility, experience, and education (Appendix B) and created competencies appropriate for each tier. The four tiers are
  - Entry-level or basic
  - Mid-level
  - Supervisory
  - Senior scientist/Researcher

- Skill domains, competencies, and subcompetencies.
  The AECs are organized according to the eight skill domains defined by the COL. Within each skill domain is a high-level competency statement, followed by subcompetency and, in some cases, sub-subcompetency statements that detail the specific knowledge, skills, and abilities necessary to meet the required competency. Many of the AECs originated in the COL competency set but have been modified to reflect the particular needs of epidemiologic practice. Additional competencies have been added throughout all of the skill domains to capture specific skills and knowledge necessary for epidemiologists in public health agencies. The Analytic/Assessment and Basic Public Health Sciences skill domains are the most closely linked to applied epidemiologic practice and therefore have received the greatest number of new, epidemiology-specific competencies.

Intended Use

The AECs define the discipline of applied epidemiology as practiced in government agencies. The intended uses vary by category of user and include the following:

- Practitioners
  - Assessing current skills
  - Creating career development plans
  - Planning specific training and educational needs
- Employers
  - Creating career ladders for employees
  - Developing position descriptions and job qualifications
  - Developing training plans for employees
  - Assessing epidemiologic capacity of an organization
- Educators
  - Designing education programs that meet the needs of public health agencies
  - Incorporating critical elements of epidemiologic practice into existing coursework

Dissemination

CDC and CSTE intend to disseminate the AEC document broadly throughout the epidemiology and public health communities. The final competency set will be presented at multiple state, regional, and national public health and epidemiology meetings that focus on educating the target audiences about the development and use of the AECs. Detailed information about the development process, as well as examples of the intended use of the AECs and case studies from sites where they are used, will be published in major public health journals. Finally, complete information about the AECs will be available on the CDC (www.cdc.gov/AppliedEpiCompetencies) and CSTE (www.cste.org/competencies.asp) Web sites. CDC and CSTE also intend to develop a tool kit to support adoption and use of the AECs, which also will be available on the CDC and CSTE Web sites.

Conclusion

CDC and CSTE anticipate the AECs will be used as the basis of instructional competencies for training government epidemiologists and as the framework for developing position descriptions, work expectations, and job announcements for epidemiologists practicing in public health agencies. Once public health agencies have used them for a period of time, CDC and CSTE will evaluate their utility and effectiveness as part of an ongoing process to update and improve them.

Acknowledgement

CDC and CSTE sincerely appreciate the extensive effort by the members of the expert panel in developing the AECs. We also greatly appreciate the interest of the public health and epidemiology communities across the country and the many individuals who reviewed and commented on the draft AECs. We look forward to their continuing engagement and support in using these competencies to improve the practice of applied epidemiology.

Appendix A: Panel Members

Convened by the Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists (CSTE)

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Appendix B: Competency Development Process

The expert panel began by examining and refining existing public health and epidemiologic competencies. Next, the panel mapped the existing competencies to the skill domains within the Core Competencies for Public Health Professionals,[7] a competency framework developed by the Council on Linkages Between Academia and Public Health Practice (COL) through an extensive process. The COL defined eight skill domains for public health practitioners:

- Analytic/Assessment Skills
- Policy Development/Program Planning Skills
- Communication Skills
- Cultural Competency Skills
- Community Dimensions of Practice Skills
- Basic Public Health Sciences Skills
- Financial Planning and Management Skills
- Leadership and Systems Thinking Skills

The expert panel determined that expectations for all epidemiologists should be based on the general skills outlined in the COL core competencies, and individuals and organizations should reference the COL core competencies as part of any career development activity.

Although the COL core competencies were deemed appropriate for all epidemiologists, the expert panel recognized that the COL document did not adequately address the unique elements of epidemiologic practice. Therefore, the panel focused on articulating the particular knowledge, skills, and abilities required to carry out epidemiologic activities. The AEC document used the COL domains, but lists them in a different order.

In the resulting competency set, each skill domain includes multiple competency statements. The expert panel added subcompetency statements and additional detail to clarify the intent and scope of many of the AECs. Although many of the competencies may be appropriate for epidemiologists in a wide variety of public- and private-sector settings, the document focuses on the knowledge, skills, and abilities that pertain to the practice of applied epidemiology in a government public health agency.

The expert panel developed the AECs in four tiers, each focusing on epidemiologists whose levels of experience and responsibilities differ from those in the other tiers:

[7] Public Health Foundation. Council on Linkages Between Academia and Public Health Practice. Available at http://www.phf.org/Link.htm. Accessed May 31, 2006.

Level	Examples of Functional Responsibility	Examples of Educational and Experiential Criteria
Tier 1—Entry-level or basic epidemiologist[8]	Carries out simple data collection, analysis, and reporting in support of surveillance and epidemiologic investigations.	• Newly graduated Master's degree with minimal experience but from a Master's program with a focus on epidemiology and/or analysis and assessment; or • Bachelor's or other nonepidemiology professional degree or certification (e.g., RN, MD/DO, DDS/DMD, DVM, PhD, RS) without formal academic epidemiology training and with at least 2 years' experience performing epidemiology work under the guidance[9] of a Tier 2 or Tier 3 epidemiologist.
Tier 2—Mid-level epidemiologist	Carries out simple and more complex and nonroutine data collection, analysis, and interpretation task and can work independently; or may supervise a unit or serve as a project leader or surveillance coordinator.	• Master's degree with a focus in epidemiology with 2 or more years' work experience in epidemiology in a public health agency; or • Doctoral level epidemiologist; or • Other nonepidemiology professional degree or certification (e.g., RN, MD/DO, DDS/DMD, DVM, PhD, RS) with specific epidemiology training (e.g., MPH degree, CDC Epidemic Intelligence Service program) or at least 4 years' experience performing epidemiologic work under the guidance of a Tier 3 epidemiologist.
Tier 3 a & b— Senior-level epidemiologist	3a: supervisor and/or manager, director of a major section, program, or bureau in a public health agency.	• A master's degree with a focus in epidemiology and ≥ 4 years' work experience in epidemiology in a public health agency; or • A doctoral-level degree in epidemiology, supplemented with ≥ 2 years' work experience at a Tier 2 Epidemiologist level; or • Other non epidemiology professional degree or certification (e.g., RN, MD/DO, DDS/DMD, DVM, PhD, RS) with specific epidemiology training (e.g., MPH degree, CDC Epidemic Intelligence Service program) and ≥ 4 years' work experience at a Tier 2 epidemiologist level.

[8] Entry-level or basic epidemiologists include persons who may not be titled an epidemiologist but who perform epidemiology functions at least part-time.

[9] Guidance can be received from an epidemiologist in the same agency or in other organizations.

Level	Examples of Functional Responsibility	Examples of Educational and Experiential Criteria
	3b: senior scientist/subject area expert in an epidemiologic focus area.	• A master's degree with a focus in epidemiology and ≥ 4 years' work experience in epidemiology in a public health agency; or • A doctoral-level degree in epidemiology, supplemented with ≥ 2 years' work experience at a Tier 2 Epidemiologist level; or • Other non epidemiology professional degree or certification (e.g., RN, MD/DO, DDS/DMD, DVM, PhD, RS) with specific epidemiology training (e.g., MPH degree, CDC Epidemic Intelligence Service program) and ≥ 4 years' work experience at a Tier 2 epidemiologist level.

CDC and CSTE do not intend these tiers to be rigid categories for practicing epidemiologists but rather to guide epidemiologists and public health agencies in understanding typical expectations for persons who perform the kinds of epidemiologic activities described in each tier. Similarly, the descriptions of the tiers are intended to provide general guidance, not to prescribe how a given person qualifies for a specific tier.

The expert panel initially focused on Tier 2 epidemiologists. The panel developed and modified competencies to define expectations appropriate for persons practicing at the Tier 2 level. The panel then used the Tier 2 competencies as a base to create competencies appropriate for Tier 1 and Tier 3a and 3b epidemiologists.

[7] Public Health Foundation. Council on Linkages Between Academia and Public Health Practice. Available at http://www.phf.org/Link.htm. Accessed May 31, 2006.

Validation Process

After creating the first draft of Tier 2 competencies, the expert panel developed a survey to collect feedback from the practice community on the appropriateness and validity of the proposed competency statements. The survey presented all of the high-level competency statements within each skill domain and for each competency asked

- Do you do this, and if so, how often do you perform this task?
- Is this competency appropriate for a Tier 2 epidemiologist?

At the end of each skill domain, the survey also asked whether any competencies were missing and whether the respondent suggested any changes. Each respondent also was asked to self-identify as a Tier 1, 2, 3a, or 3b epidemiologist on the basis of the tier definitions provided by the expert panel.

The draft Tier 2 competencies were first presented to the public in June 2005 at CSTE's annual meeting. All attendees were asked to complete the survey; 259 persons responded. In addition, a notice asking for others to respond was sent to 14 professional organizations: Association of State and Territorial Health Officials; National Association of County and City Health Officials; American College of Epidemiology; Society for Epidemiologic Research; Association of American Medical Colleges; Association of Teachers of Preventive Medicine; Association of Schools of Public Health; Association of Maternal and Child Health Programs; National Environmental Health Association; National Association of Local Boards of Health; Association of State and Territorial Directors of Nursing; State and Territorial Injury Prevention Directors Association; American Public Health Association; and National Association of Chronic Disease Directors. To facilitate responses from this broader audience, the survey was placed on the CSTE Web site, resulting in 121 additional responses.

After developing the draft Tier 2 competencies, the expert panel developed draft competency statements for Tiers 1, 3a, and 3b. These draft statements, along with the original form of the Tier 2 competencies, were used in the final validation process.

The complete draft of all competency statements was posted to CSTE's Web site, along with a revised Web-based survey that included separate sections for each tier. The survey instructions asked respondents to focus on the tier with which they self-identified and, if appropriate, to comment on other tiers on which they felt qualified. The survey also collected respondents' basic demographic information and self-identified tier.

As in the first round, professional organizations were asked to encourage their members to respond to the survey, with the National Association of Health Data Organizations and the American College of Preventive Medicine added to the list. Information also was published in the *MMWR* and featured prominently on the CSTE Web site.

In addition to the general requests for response, CDC and CSTE asked state epidemiologists to volunteer to solicit more comprehensive response in their own states. Three states volunteered—Kentucky, Connecticut, and Tennessee—and in each, the state epidemiologist encouraged all epidemiologists employed by the state to respond to the survey. The three state epidemiologists also encouraged any epidemiologists employed by local health departments to respond. Because of this outreach effort, response in these three states was particularly high, averaging 96%.[10]

CSTE received 420 responses to the survey regarding the four tiers.

[8] Entry-level or basic epidemiologists include persons who may not be titled an epidemiologist but who perform epidemiology functions at least part-time.

[9] Guidance can be received from an epidemiologist in the same agency or in other organizations.

Tier	Domain of Practice						
	Academic	Federal	Local	Other	State	Unknown	TOTAL
1	7	22	71	9	74	0	183
2	8	17	50	8	81	2	166
3a	0	8	13	0	22	1	44
3b	3	8	3	1	10	2	27
TOTAL (%)	**18 (4)**	**55 (13)**	**137 (33)**	**18 (4)**	**187 (45%)**	**5 (1)**	**420**

Final Editing and Review Process

For the final editing process, the consultant/editor, the conveners, and co-chairs reviewed all comments from all survey respondents in the first round (Tier 2 only) and the second round (all tiers). The comments were categorized according to whether they proposed a new competency, suggested a rewrite or found a statement confusing, stated the competency was not appropriate, or provided a general comment.

For the first two categories, the expert panel reviewed the proposed changes and determined whether to accept the change, accept the change with modifications, or not accept the change. For the second two categories, the expert panel identified major trends or concerns and addressed them either by changing the competency statements or clarifying statements in the Preface to the competency document. Many of the suggested changes focused on the tier definitions, and the expert panel reviewed and revised these as well.

In addition to analyzing the qualitative data, the expert panel reviewed the quantitative data from the surveys. The panel discussed any competency statement for which overall agreement with the question "Is this an appropriate competency?" fell below 75% and decided whether to retain or to change the competency. The acceptance level for the draft competency statements was very high, and fewer than 8% fell below that threshold.

After final discussion, review, and editing, the expert panel agreed the AECs were complete.

[10] The response rate for these three states was estimated on the basis of the number of respondents participating on behalf of the volunteer states compared with the total number of epidemiologists in each state as identified in CSTE's 2004 Epidemiology Capacity Assessment.