



Northwest Center for Public Health Practice

at the University of Washington School of Public Health and Community Medicine

The Northwest Center for Public Health Practice (NWCPHP) has developed competency-based epidemiology training materials for public health professionals in practice. Epidemiology is broadly accepted as a core public health science, but public health professionals have varying levels of expertise with, or need for, epidemiological tools. Different job functions in public health also require differing levels of epidemiology skill; however, the need for some level of epidemiology fluency has increased for all public health workers with the increased emphasis on bioterrorism preparedness. Providing continuing education in practice-based epidemiology is therefore a key activity for public health workforce development. A variety of practice-based epidemiology trainings have been developed, but many of these do not address recent public health workforce development trends that emphasize training to specific public health competencies. Therefore, the goal of this project was to develop a competency set for public health epidemiology, with accompanying curricula and instructional materials for short courses in epidemiology.

This document contains the competencies, sub-competencies and learning objectives that have been developed in 9 areas of epidemiological practice. The learning objectives are those appropriate for frontline staff and for senior level technical staff, as suggested by the Council on Linkages Between Academia and Public Health Practice.

In parallel with the development of this competency set, we have identified and organized practice-based instructional materials that map to each competency, and to specific learning objectives. These materials, which are available on the NWCPHP website, include examples, case studies and exercises that can be used as tools to create competency-based training modules by local trainers. The NWCPHP has also developed online competency-based learning modules to provide additional epidemiology learning opportunities for local and state level public health professionals.

This project was initiated by James L. Gale, MD, MS, Professor Emeritus of Epidemiology in the School of Public Health & Community Medicine at the University of Washington and principal investigator of the CDC Center for Public Health Preparedness at the NWCPHP. Current project team members include Janet Baseman, PhD, MPH; Victoria Holt, PhD, MPH; and Andy Stergachis, PhD, RPh.

We welcome input from the public health practice community and the academic community on the development of these public health epidemiology competencies. Please contact nwcpHP@u.washington.edu with any comments or suggestions.



Competency 1

Describe the role of epidemiology in public health

A. Utilize the terminology and definitions of epidemiology

1. Define epidemiology
2. Identify and summarize basic concepts and principles of epidemiology
3. List and define disease rate terms used in epidemiology (incidence, prevalence, attack rate, adjusted rate, cause specific rates)

B. Describe the role of epidemiology in public health practice

1. Outline the history and development of epidemiology
2. List at least 8 areas in which public health professionals utilize epidemiology (outbreak investigation, surveillance, interpreting public health literature, screening, natural history studies, assessing causation, describing the health status of a population, evaluating a program or treatment)
3. Describe the relationship between epidemiologic research and disease prevention and control
4. Describe the use of epidemiologic data to inform ethical, political, economic issues



Competency 2

Design and conduct an outbreak investigation

A. Monitor for recognition of a potential disease outbreak

1. List four sources of information that might be used to indicate unusual disease activity (clinicians, patients, surveillance data, media)

B. Determine if a potential outbreak exists

1. Evaluate the quality of information from various sources of disease reporting
2. Describe the concept of background occurrence of a disease
3. Identify what constitutes an unusual occurrence of a disease and a potential outbreak

C. Obtain help to assess and manage the potential outbreak

1. Identify local, regional, state, federal, international, and tribal agencies and jurisdictions involved with case investigations, outbreak investigations, and responses to the public or media
2. Describe roles of local, state, and federal governmental authorities in conducting an outbreak investigation
3. List steps to obtain permission/cooperation from responsible authorities to proceed with an investigation

D. Establish a case definition based on person, place and time

1. Collect information to formulate the demographic and temporal description of the apparent outbreak
2. Organize data into a line-listing using computer software

E. Create a matrix of possible causation based on known toxic/infectious agents

1. Locate information describing common pathogens (exposures) from state or university resources, publications, Internet sites
2. Define and interpret the terms 'latent period' and 'incubation period' and determine these periods for common pathogens



F. Establish the background rate of disease

1. Utilize existing surveillance data at local, state, and national levels to determine the background rate of occurrence of the disease

G. Find additional cases, determine extent of the outbreak

1. Identify the steps in investigating an individual case
2. Define purpose and formulate content of a case interview
3. Define purpose and formulate content of a contact investigation

H. Examine the descriptive features of the outbreak

1. Generate and interpret epidemic curves from outbreak or case cluster data
2. Define and interpret basic descriptive epidemiology measures such as prevalence, incidence, case fatality, mortality
3. Calculate basic descriptive epidemiology measures such as prevalence, incidence, case fatality, mortality

I. Formulate a hypothesis of disease causation

1. Choose an appropriate study design for a given research question
2. Formulate the null and alternative hypothesis for a given research question and study design

J. Test the hypothesis of disease causation

1. Identify appropriate subjects for a given research question and study design
2. Define and contrast the terms: validity, reliability, precision and accuracy
3. Define exposure and outcome in a study and set up a 2x2 table to show the relationship between exposure and outcome

K. Collect and test clinical and environmental samples

1. List and describe the procedures for collecting, storing and transporting human samples from various sites (i.e. nasal, blood, throat, stool)
2. List and describe the procedures for collecting, storing and transporting environmental samples from various substances (e.g., water, soil, food, air, workplace surfaces, animal)
3. Identify environmental specialists to contact for assistance with environmental sampling



L. Put control measures into effect

1. List resources necessary to establish special surveillance for emergency situations

M. Interact with the public and the media

1. Identify key results that are important to convey to the public
2. Develop a communication plan using a designated spokesperson
3. List media sources to contact about an outbreak
4. Convey public health information to the media about the outbreak



Competency 3

Define terms and concepts associated with infectious diseases

A. Define concepts commonly used in infectious disease epidemiology

1. Define and discuss the significance of the following concepts: incubation period, virulence, reservoir, period of communicability, prodromal period, infective dose, diagnosis, disease course, treatment [if any], susceptible populations, vectors
2. Describe several ways epidemiologists classify infectious disease agents (i.e. by type of agent, by incubation period, by locality of occurrence, by severity of illness, by mode of transmission, by duration [acute vs.chronic], by vector)
3. Describe the relationship between agent, host and environment and the significance of this relationship to infectious disease epidemiology

B. Describe classifications and characteristics of infectious disease agents

1. List and compare characteristics of bacteria, viruses, protozoa, rickettsiae, prions, etc.
2. List diseases associated with each type of organism
3. List the agent characteristics that influence human acquisition of infections (i.e. ability to live outside a host; ability to survive in unfavorable environments; ability to shift antigenicity; ability to induce or not induce immune response)

C. Describe characteristics of hosts relevant to infectious disease acquisition

1. List the host characteristics that influence susceptibility to infectious diseases (i.e. age, sex, behavior, social environment, immunity, history of travel, occupation)

D. Describe the role of the environment in infectious disease acquisition

1. List the environmental conditions that influence infectious disease occurrence (i.e., temperature, humidity, water quality, geography, locality)

E. Describe the role of vaccination in infectious disease prevention

1. Define and contrast natural and acquired immunity
2. List available vaccines for various infectious diseases and define target audience for vaccination
3. Describe and discuss the strengths and weaknesses of vaccines and vaccination programs



Competency 4

Define, describe, interpret, and install public health surveillance systems

A. Define surveillance and describe its use in public health

1. Define surveillance (the ongoing systematic collection, analysis, interpretation and dissemination of health data)
2. Define and describe different approaches to surveillance (active vs. passive, notifiable disease reporting, lab-based, volunteer providers, registries, surveys, information systems, sentinel events, record linkages)
3. Describe the objectives of public health surveillance (detection of outbreaks, projection of disease trends, evaluation of interventions, links to services, links to research, education and policy)
4. List the elements of a surveillance system (such as case definition, population identification, cycle of surveillance, confidentiality, incentives to participation)

B. Determine public health surveillance data quality

1. List and evaluate the quality of the common sources of existing surveillance data at local, state, and national levels
2. Describe limitations of the use of mortality data (such as comparing two different populations, use of death certificate data)

C. Recognize steps in establishing surveillance systems

1. Explain the legal basis of notifiable disease reporting
2. Identify diseases with mandated reporting (state, national, and international levels)
3. Recognize differing time frames for reporting of different diseases

D. Analyze surveillance data

1. Identify appropriate descriptive measures of disease frequency
2. List and consider potential confounding factors in analyses
3. Determine time trends in disease frequency



E. Interpret surveillance data analyses

1. Identify factors other than actual disease frequency changes that could lead to apparent changes (changes in disease definition, surveillance system protocols, status as notifiable disease, etc.)
2. Present and summarize data through use of frequency distributions, histograms, summary statistics

F. Evaluate surveillance systems

1. Identify the CDC list of the attributes of surveillance that can be used to evaluate an existing surveillance system or to conceptualize a proposed system



Competency 5

Obtain, evaluate and interpret public health information

A. Interpret epidemiology measures

1. Define and contrast crude and adjusted disease rates
2. Define exposure and outcome in a study and set up a 2x2 table to show the relationship between exposure and outcome
3. Identify the difficulties in concluding that a given exposure causes an outcome of interest
4. Define confounding and identify its presence in a study
5. Define and interpret epidemiological measures of association such as relative risk, odds ratio, attributable risk, population attributable risk, standardized mortality ratio, proportional mortality ratio
6. Define and interpret basic descriptive epidemiology measures such as prevalence, incidence, case fatality, mortality

B. Design a study

1. Define and identify different study design types (such as, cohort, case-control, cross-sectional, ecologic, randomized trial, systematic review, meta-analysis)
2. List the common sources of information used to characterize the descriptive epidemiology of a disease and some strengths and limitations of those information sources
3. Compare the strengths and weaknesses of different study designs (such as, cohort, case-control, cross-sectional, ecologic, randomized trial, systematic review, meta-analysis)
4. Identify differences between observational/descriptive and experimental studies
5. Choose an appropriate study design for a given research question
6. Identify appropriate subjects for a given research question and study design
7. Define and compare/contrast the strengths and weaknesses of prospective and retrospective study designs



8. Identify the essential elements of randomized controlled study design
9. Describe the advantages of randomized controlled trials in assessing new interventions
10. Identify common problems with the interpretation of randomized controlled trials

C. Explain the role of bias in interpretation of study results

1. Identify sources of bias in a given study
2. Identify sources of bias in a survey instrument
3. Explain the importance of and differences between validity and generalizability of a study
4. Define and contrast the terms: validity, reliability, precision and accuracy

D. Identify and distinguish concepts in biostatistics

1. Define and interpret basic biostatistical measures such as the mean, median, confidence interval, p-value
2. Define and recognize the three major types of systematic distortion in study designs (information bias, selection bias, confounding)
3. Define and interpret basic biostatistical measures such as the mean, median, confidence interval, p-value
4. Identify when it is appropriate to use a chi-square test, t-test, correlation or linear regression
5. Describe the concept of statistical power in research studies
6. Define type I and type II error

E. Apply epidemiological information

1. Read and interpret graphics describing disease patterns in populations
2. Identify the proper techniques for evaluation of a health services program
3. Use a statistical program and interpret output
4. Describe the most prevalent diseases in your community in terms of: patterns, etiology, risk factors, clinical aspects, and prevention and control



Competency 6

Collect, organize, prepare and display epidemiologic data

A. Define different types of data

1. Identify differences in types of data (such as qualitative/categorical variables vs. quantitative variables)

B. Design a data management strategy

1. Identify the key features of new variable generation during data collection
2. Define the appropriate format and range of permissible values of a new variable
3. Describe the goals and purpose of use of a database for information generation
4. Define the types of databases available for data management
5. Identify the features of a well-designed database
6. Describe the importance of a data dictionary or codebook of variables
7. Identify coding procedures for missing data
8. Describe the importance of data entry checks and validation
9. Identify the benefits of and strategies for proper documentation of the data management process
10. Design an appropriate system of backing up and archiving data



C. Present data graphically

1. Summarize and present data through use of frequency distributions, histograms, summary statistics
2. Define and contrast the terms: validity, reliability, precision and accuracy correctly prepare tables with one, two and three variables
3. Prepare arithmetic-scale line graphs, semilogarithmic-scale line graphs, frequency polygons, and scatter diagrams
4. Construct bar charts, pie charts, spot maps, area maps, and box plots
5. Generate epidemic curves outbreak data
6. Explain when to use each type of table, graph, and chart



Competency 7

Evaluate the efficacy or effectiveness of a screening program

A. Explain the purposes of screening

1. Describe the role of screening in secondary prevention of disease
2. Identify some successes and failures of specific screening programs employed in the U.S.

B. Identify appropriate screening criteria

1. Define the criteria that must be met to make a disease suitable for screening

D. Identify and explain measures of validity

1. Define and interpret measures of validity of a screening test (sensitivity and specificity)
2. Calculate the sensitivity and specificity of a screening test
3. Explain the significance of sensitivity and specificity in determining whether a screening tool is a good one

E. Identify and explain the predictive values of a positive and negative test

1. Calculate the positive and negative predictive values of a screening test
2. Describe the relationship between predictive value positive of a screening test and prevalence of disease in the population being screened
3. Explain the significance of the positive and negative predictive values in deciding whether to implement a screening program

E. Establish and evaluate screening programs

1. Describe the difference between efficacy and effectiveness
2. Identify the measures of disease frequency that are important to monitor when evaluating the performance of a screening program



Competency 8

Design and implement surveys and questionnaires

A. Develop questionnaires

1. Design and implement a questionnaire (Who should conduct it? What questions should be asked? What should the format be?)
2. Develop a measurement instrument that maximizes validity and reproducibility
3. Choose appropriate items to be included in a questionnaire
4. Compare and contrast different types of survey questions (e.g. open vs. closed ended questions)
5. List and define options for content of questions (e.g. knowledge, beliefs, attitudes, behaviors, attributes)
6. Properly word survey questions for clarity and lack of bias
7. Properly format and order individual questions
8. Properly ask questions about items of interest that vary over time
9. Choose an appropriate length of a survey and describe how to consider other aspects of respondent burden
10. Design questionnaire forms that decrease the likelihood of measurement error



Competency 9

Design and conduct program evaluations

A. Describe the significance of program evaluation

1. List the reasons for evaluating a program (to determine program performance; to determine whether a program should continue, be discontinued, or changed; compare different programs or versions of a program, etc.)
2. Define the different roles an evaluator can take (participatory, objective, advocate)
3. Describe ethical issues in program evaluation and list the five key principles from the American Evaluation Association: systematic inquiry, competence, integrity/honesty, respect for people, and responsibilities for general and public welfare

B. Formulate the question(s) the evaluation will answer

1. Apply program theory and program objectives to form questions
2. Recognize how to work with the organization's decision makers to refine questions
3. Recognize how the age of the program may influence results
4. Develop plans for budget, staff and logistical needs

C. Design the best evaluation for a particular program

1. Distinguish when it is best to use an outcome evaluation, process (or implementation) evaluation or a combination of both
2. Contrast the types of questions used in outcome and process evaluations
3. Compare and contrast quantitative designs ("pre-experimental", experimental, quasi-experimental)
4. Identify external and internal validity threats present in each of the quantitative designs
5. List the features of a qualitative design



D. Conduct the evaluation

1. Identify the target population
2. Determine whether sampling should be random or non-random
3. Select the sampling design and calculate sample size requirements
4. Identify measures to be collected
5. Assess reliability, validity and responsiveness of measures
6. Determine appropriate data sources for each measure
7. Prepare and execute a data collection plan
8. Analyze evaluation data

E. Disseminate results of the evaluation

1. Translate results back into policy and develop recommendations
2. Design a dissemination plan for policy recommendations