Principles of Epidemiology Workbook

Exercises and Activities

Ray M. Merrill, PhD, MPH, MS
Department of Health Science
Brigham Young University
Provo, Utah

JONES & BARTLETT
LEARNING
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World Headquarters
Jones & Bartlett Learning
40 Tall Pine Drive
Sudbury, MA 01776
978-443-5000
info@jblearning.com
www.jblearning.com

Jones & Bartlett Learning Canada
6339 Ormindale Way
Mississauga, Ontario L5V 1J2
Canada

Jones & Bartlett Learning International
Barb House, Barb Mews
London W6 7PA
United Kingdom

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For Grant, whose dedicated service to people less fortunate
than himself has been an inspiration to me.

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Preface

This workbook was written for students of epidemiology and serves as a supplement to classroom instruction and independent study. Chapters are generally divided into an introduction, a series of questions and detailed responses, and several homework problems.

The general learning outcomes (LOs) for this workbook are:

1. Become familiar with basic concepts and definitions commonly used in epidemiology.
2. Define a public health problem.
3. Identify appropriate uses and limitations of data and research design strategies for solving public health problems.
4. Make relevant inferences from quantitative and qualitative data.
5. Distinguish between statistical association and cause–effect relationships.
6. Measure and describe patterns of disease incidence, prevalence, and mortality.
7. Identify environmental factors and behaviors associated with health-related states or events.
8. Be familiar with the steps for investigating disease outbreaks.
9. Identify, calculate, and interpret common indices used in determining health status.
10. Evaluate program effectiveness.
11. Critically assess epidemiological research.
12. Communicate health findings.

Each of the workbook's 12 chapters relates to selected learning outcomes:

1. Foundations of Epidemiology
   LO1, LO2, LO10, LO12
2. History of Epidemiology
   LO1, LO4
3. Practical Disease Concepts in Epidemiology
   LO1, LO7
4. Descriptive Epidemiology
   LO2, LO3, LO6, LO10, LO11, LO12
5. Frequency Measures Used in Epidemiology
   LO6, LO9
6. Analytic Epidemiology
   LO3, LO7, LO10, LO11
7. Experimental Studies
   LO3, LO10, LO11

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8. Statistical Hypothesis Testing in Epidemiology
   LO4, LO7
9. Causal Inference
   LO5, LO7
10. Field Epidemiology
    LO2, LO7, LO8
11. Chronic Disease Risk Factors
    LO7
12. Screening for Disease
    LO10

Mastery of the selected learning outcomes will be assessed using questions that take into account the six cognitive process dimensions developed by Anderson and Krathwohl.[1]

1. Remember
   a. Recognizing—locating knowledge in long-term memory that is consistent with presented material (e.g., identifying important disease concepts)
   b. Recalling—retrieving relevant knowledge from long-term memory (e.g., recalling the key events and people contributing to the field of epidemiology)
2. Understand
   a. Interpreting—changing from one form of representation (e.g., numerical) to another (e.g., verbal) (a person with a body mass index greater than 30 is obese; a relative risk estimate above 1 indicates a positive relationship between an exposure and disease outcome; a population-attributable risk percent of 30 indicates that 30% of the health outcome is associated with a given exposure)
   b. Exemplifying—finding a specific example or illustration of a concept or principle (e.g., giving examples of the types of potential bias in a case–control study)
   c. Classifying—determining that something belongs to a category (e.g., classifying a study design as descriptive or analytical; determining whether data are nominal, ordinal, categorical, or continuous; identifying whether a person is in a risk category for disease or injury)
   d. Summarizing—abstracting a general theme or major point(s) (e.g., writing a short summary of the information presented in a graph or table)
   e. Inferring—drawing a logical conclusion from information (e.g., predicting the number of people likely to become infected based on past patterns of the illness)
   f. Comparing—detecting correspondences between two ideas, objects, and the like (e.g., identifying similar behaviors among disease cases)
   g. Explaining—constructing a cause-and-effect model of a system (e.g., explaining a disease process using a web of causation, an epidemiologic triangle model, or Rothman's causal pies)
3. Apply
   a. Carrying out or using—e.g., conducting an epidemiologic field investigation; implementing a public health intervention; performing a test; using a given study design in appropriate situations; age-adjusting rates
4. Analyze
   a. Differentiating—distinguishing relevant from irrelevant parts or important from unimportant parts (e.g., separating relevant and irrelevant explanations for disease)
   b. Organizing—determining how elements fit into or function within a structure (e.g., identifying stages of disease progression)
   c. Attributing—relating to a particular cause, source, or characteristic (e.g., comparing health outcomes according to exposure classifications in order to attribute whether the exposure increases the risk of disease)

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5. Evaluate
   a. Checking—monitoring or testing for consistency (e.g., determining internal validity [the extent to which the results of a study are true for the target population] and external validity [the degree that the results of a study may be generalized to other populations]; determining the efficacy and effectiveness of an intervention)
   b. Judging—concluding based on criteria and standards (e.g., causal inference; statistical inference)
6. Create
   a. Hypothesizing—positing alternative hypotheses based on criteria (e.g., generating hypotheses to account for an observed phenomenon)
   b. Planning—devising a procedure for accomplishing a task (e.g., planning a research study to investigate a given health problem)
   c. Designing—devising a product (e.g., developing a public health intervention)[1]

At the end of each chapter is a set of homework problems. The primary cognitive processes involved in the chapter homework problems are identified in the following table:

Chapter	Remember	Understand	Apply	Analyze	Evaluate	Create
1	✓	✓				
2	✓	✓				
3	✓	✓				
4	✓	✓	✓	✓		
5	✓	✓	✓	✓		
6	✓	✓	✓	✓	✓	
7	✓	✓	✓	✓	✓	
8	✓	✓	✓	✓	✓	✓
9	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓
11	✓	✓	✓	✓	✓	✓
12	✓	✓	✓	✓	✓	

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1. Anderson, L. W., and D. R. Krathwohl (eds). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman, 2001.

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About the Author

Ray M. Merrill, PhD, MPH, MS, is a professor of epidemiology and biostatistics at Brigham Young University. He is a fellow of the American Academy of Health Behavior and of the American College of Epidemiology. He is a former fellow of the National Cancer Institute and of the International Agency for Research on Cancer. He holds adjunct positions in the Department of Family and Preventive Medicine and the Department of Health Promotion and Education at the University of Utah.

Dr. Merrill's research involves analysis and modeling of trends in chronic disease incidence, mortality, and survival data; investigation of the impact of chronic disease treatment advances and increased utilization of screening tests on population disease statistics; methodologic investigations into new chronic disease measures; the relationships between incidence, mortality, and survival; and the impact of various biases on chronic disease statistics.

In addition to this book, he is the author of *Reproductive Epidemiology: Principles and Methods* (Jones & Bartlett 2010), *Introduction to Epidemiology* (Jones & Bartlett 2010), *Environmental Epidemiology* (Jones & Bartlett 2008), and more than 180 peer-reviewed publications. He is active in several professional organizations in public health.

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