Core Knowledge Expectations for Graduate Students Training in the Population Health Section, Department of Clinical Sciences, Colorado State University

Approved 8/2/2010

All graduate students whose major advisors are members of the Population Health Section are expected to master core knowledge topics that are relevant to population health and epidemiology. These requirements have been determined by consensus of the Section faculty.

Determining Mastery of Core Knowledge Topics: Each student's graduate committee is charged with ensuring that students have appropriately mastered these topics. Graduate committees may amend this list of topics but students will generally be expected to master all of the topics listed. The appropriate depth of knowledge will vary as deemed appropriate by the graduate committee (i.e., PhD students will generally be expected to have a more thorough understanding of the topics in comparison to MS students). Students must demonstrate mastery of this material during the Thesis Defense examination for MS students, or the Qualifying Examination for PhD students. Demonstrating mastery of these topics is the minimum requirement for passing these examinations.

Core Knowledge Expectations:

- Describing disease occurrence
  - Incidence (risk and rate)
  - Prevalence
  - Case-fatality
  - Survival
  - How are these measured?
  - How are they interpreted?
  - Advantages/Disadvantages
- Identifying determinants of disease
  - Causality
    - Causal inference (Koch, Evans, Susser, etc.)
    - Causal models (Web, Component, etc.)
  - Measures of association
    - Relative risk, odds ratio, attributable risk, attributable fraction
    - How are these measured, interpreted?
    - Strength of association
- Principles of infectious disease transmission
  - Transmission routes
  - Temporal patterns
  - Disease states
  - Reservoirs
  - Epidemiological triad
  - Pathogenicity, virulence, infectiousness, contagiousness, etc.
  - Disease transmission methods
- Outbreak investigations
- Validity – Internal and external
  - Bias
    - Selection bias
    - Information bias
    - Confounding bias
    - When does bias occur?
    - How is it controlled?
    - Non-response / non-participation / non-probability sampling
- Sampling
  - Design of sampling strategies
  - Sample size estimation

- Study design
  - Hypothesis development
  - Types
    - Cohort
    - Case-control
      - Defining a case
      - Selecting controls
    - Cross-sectional
    - Randomized clinical trials
  - Choice of study design
    - Advantages/Disadvantages
    - When to use which design
  - Obtaining unbiased survey data
    - Question design and format
    - Cultural, language, and interviewer effects.
  - Handling clustering
  - Internal validity
  - External validity
- Clinical tests
  - Screening vs. diagnostic testing
  - Sensitivity and specificity
  - True vs. apparent prevalence
  - Predictive values
  - Multiple testing
  - Cut-off values / ROC curves
  - Animal level vs. herd-level testing
- Data analysis and management
  - Database structures
  - How to build and manage
- Statistics and how to interpret results
  - How do you choose a statistical test for a given situation?
  - Specific statistical procedures
    - Basic tests
      - *t*-tests
      - Contingency table analysis – crude and stratified
      - Non-parametric alternatives
      - Matched pairs analyses
    - Advanced procedures: Regression and ANOVA
      - Linear and logistic regression
      - Concept behind generalized linear models
      - Model building, detection/interpretation of confounding, effect modification
      - What to do when clustering is present
  - Type I and Type II error, power, alpha
  - Common distributions of data in populations
  - Measures of summary and spread
  - P-values and confidence intervals
- Appropriately communicating concepts about population health, epidemiology, and research results
  - For the:
    - General public
    - Interested stakeholders
    - Policy / decision makers
    - Other scientists
  - Impediments to understanding epidemiological concepts
  - How to simplify communication without missing critical details

Some Epidemiology Texts that are Useful Resources:

1. Dohoo I, Martin SW, Stryhn H. Veterinary Epidemiologic Research, 2nd ed. Charlottetown: AVC Inc., 2009.
2. Greenland S. Evolution of Epidemiologic Ideas: Annotated Readings on Concepts and Methods. Chestnut Hill: Epidemiology Resources, Inc., 1987.
3. Haynes RB, Sackett DL, Guyatt GH, Tugwell P. Clinical Epidemiology: How to do Clinical Practice Research, 3rd ed. Philadelphia: Lippincott, Williams & Wilkins, 2006
4. Kelsey JL et al. Methods in Observational Epidemiology. 1996
5. Kleinbaum DG, Kupper LL, Morgenstern H, Epidemiologic research: Principles and Quantitative Methods. 1982.
6. Martin SW, Meek AH, Willeberg P. Veterinary Epidemiology: Principles and Methods. Ames: Iowa State University Press, 1987.
7. Rothman KJ. Causal Inference. Chestnut Hill: Epidemiology Resources, Inc., 1988.
8. Rothman KJ. Modern Epidemiology. Boston: Little, Brown & Company, 1986.
9. Rothman KJ and Greenland S. Modern Epidemiology. 1998
10. Sackett DL, Haynes RB, Guyatt GH, Tugwell P. Clinical Epidemiology: A Basic Science for Clinical Medicine, 2nd ed. Boston: Little Brown & Company, 1991.
11. Schwabe CW. Veterinary Medicine and Human Health, 3rd ed. Baltimore: Williams & Wilkins, 1984.
12. Susser M. Causal Thinking in the Health Sciences: Concepts and Strategies in Epidemiology. New York: Oxford University Press, 1973.
13. Thrusfield M. Veterinary Epidemiology, 3rd ed. Oxford: Blackwell Science Ltd., 2007.

Some Statistics Texts that are Useful Resources:

14. Baldi, Moore, *The Practice of Statistics in Life Sciences*, 2009
15. Fleiss, Levin, Paik, *Statistical Methods for Rates and Proportions*, 2003

General Coursework Expectations for MS and PhD students in the Population Health Section*†:

1) Fundamentals of Epidemiology (VS 580 [formerly VS796] – Fall W 3:00-5:55; 2 or 3 cr)

2) One of the following basic epidemiology courses:
   a. Epidemiologic Methods (ERHS 532) - (Fall T,Th 9:30-10:55; 3 cr)
   b. Epidemiology (EPID 6630 available by distance delivery from the Colorado School of Public Health)

3) One of the following statistics series:
   a. Applied Data Analysis (VS 662 – Spring; T,Th 3:30-5:55 – 3 cr)
   b. Biostatistics (ERHS 542[Fall] & 544[Spring] - T,Th 12:30-1:45 – 3 credits each)
   c. Statistics (STAT 510 & 511, various sections available)
   d. Applied Biostatistics (BIOS 6601 available by distance delivery from the Colorado School of Public Health)

* PhD students will also generally be expected to take Advanced Veterinary Epidemiology (VS733 [formerly VS581] -Spring odd yrs; T,Th 9-11; 4 cr)

† Course work requirements may be amended as specified by the graduate committee. Specifically, additional courses pertaining to epidemiology, statistics, or other disciplines related to the student's project area will often be required. Examples include:

- Epidemiology of Infectious Diseases/Zoonoses ERHS 533 (3 cr)
- Applied Logistic Regression ERHS 642 (3 cr)
- Advanced Epidemiology ERHS 640 (3 cr)
- Quantitative Data Collection Methods/Analysis (EDRM 700)
- Introduction to Epidemiologic Simulation Modeling (VS 796)