



AUSTRALIAN AND NEW ZEALAND COLLEGE OF VETERINARY SCIENTISTS

MEMBERSHIP GUIDELINES

Veterinary Epidemiology

INTRODUCTION

These Membership Guidelines should be read in conjunction with the *Membership Candidate Handbook*.

The Epidemiology Chapter of the Australian College of Veterinary Scientists was formed to provide a means for accreditation of veterinarians who are trained and accomplished in the discipline of epidemiology, to encourage its application by veterinarians and to foster high standards of training in veterinary epidemiology within Australia and New Zealand.

Members of the Chapter include veterinarians employed in conventional veterinary practice, private consultancy practice (this includes consultancy in Australia and internationally), universities, government departments (including agricultural, food and health portfolios), and research organisations. Chapter members work over diverse areas, including disease, health and production issues in cattle, pigs, poultry, sheep, aquatic species, horses, and other species, including disease and health of humans.

ELIGIBILITY

Refer to Section 2 of the *Membership Candidate Handbook*.

OBJECTIVES

Membership in the Veterinary Epidemiology chapter of the Australian and New Zealand College of Veterinary Scientists is an indication to the profession and the general public of an advanced practitioner representing a middle-tier of knowledge, competence and experience in the area of veterinary epidemiology. The candidate will, therefore, demonstrate sufficient knowledge of the fundamental concepts of veterinary epidemiology, experience in applying these concepts and the ability to provide basic epidemiological advice to veterinary colleagues.

LEARNING OUTCOMES

The candidate will demonstrate the expected level of knowledge and skills as outlined in the list of topics below.

1. The Purpose and Scope of Epidemiology:

- 1.1. The candidate will have **sound knowledge**¹ of the purpose and scope of epidemiology.
- 1.2. The candidate will be able to do the following with **sound expertise**²:
 - 1.2.1. illustrate common purposes and scope of epidemiology using examples of various applications of epidemiology in animal health.

2. Causation

- 2.1. The candidate will have **sound knowledge** of causation.
- 2.2. The candidate will be able to do the following with **sound expertise**:
 - 2.2.1. describe concepts and models of causality, and provide examples of their application.
 - 2.2.2. describe considerations when making causal inferences and provide examples of their application.

3. Measuring Population Health

- 3.1. The candidate will have **sound knowledge** of measuring population health.
- 3.2. The candidate will be able to do the following with **sound expertise**:
 - 3.2.1. calculate and interpret the following measurements from the information provided:
 - 3.2.1.1. measures of disease frequency — crude mortality or morbidity,

¹ Knowledge levels:

Detailed knowledge — candidates must be able to demonstrate an in-depth knowledge of the topic including differing points of view and published literature. The highest level of knowledge.

Sound knowledge — candidate must know all of the principles of the topic including some of the finer detail, and be able to identify areas where opinions may diverge. A middle level of knowledge.

Basic knowledge — candidate must know the main points of the topic and the major literature.

² Skill levels:

Detailed expertise — the candidate must be able to perform the technique with a high degree of skill, and have extensive experience in its application. The highest level of proficiency.

Sound expertise — the candidate must be able to perform the technique with a moderate degree of skill, and have moderate experience in its application. A middle level of proficiency.

Basic expertise — the candidate must be able to perform the technique competently in uncomplicated circumstances.

prevalence, attack risk³, incidence risk, incidence rate

- 3.2.1.2. measures of association — odds ratio, relative risk based on attack risk, prevalence ratio, incidence risk ratio, incidence rate ratio
 - 3.2.1.3. measures of effect – attributable risk, attributable fraction, population attributable risk, population attributable fraction
 - 3.2.1.4. measures of production and productivity — provide examples relevant to specific livestock production systems.
- 3.2.2. describe objectives of standardisation of measures of disease frequency.

4. Application of Diagnostic Tests

- 4.1. The candidate will have **sound knowledge** of the application of diagnostic tests and be able to explain the concepts behind the characteristics of diagnostic tests.
- 4.2. The candidate will be able to do the following with **sound expertise**:
 - 4.2.1. calculate and interpret the following measurements from the information provided:
 - 4.2.1.1. measures of test validity — specificity, sensitivity
 - 4.2.1.2. measures of prevalence based on test results — apparent prevalence and true prevalence
 - 4.2.1.3. probability of individual status given test results — positive and negative predictive values.
 - 4.2.2. compare the application of diagnostic tests in series and in parallel and give examples of the appropriate application of each approach.
 - 4.2.3. describe effects of prior probability on predictive value and interpret specific examples using these principles including:
 - 4.2.3.1. discussing with justification the characteristics of a diagnostic test/s suitable for use in regional animal disease programs, particularly when disease prevalence is moderate-high versus low-zero.
 - 4.2.3.2. explaining how the interpretation of diagnostic test results will change over the course of a regional animal disease program aiming to reduce and then eradicate a disease.
 - 4.2.4. define herd-level sensitivity and specificity, describe major determinants of these test characteristics and determine how they should be selected in various disease surveillance scenarios.

³ Attack risk is commonly named attack rate in textbooks and the literature.
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5. Types of Epidemiological Studies

- 5.1. The candidate will have **sound knowledge** of types of epidemiological studies.
- 5.2. The candidate will be able to do the following with **sound expertise**:
 - 5.2.1. Correctly identify examples of each of the following types of epidemiological studies — survey; case report and case series; cross-sectional study; case-control study; cohort study; randomised controlled trial
 - 5.2.2. explain the strengths and weaknesses of the different study types and applicability for particular research objectives and circumstances.

6. Aspects of Epidemiological Study Design

- 6.1. The candidate will have **sound knowledge** of aspects of epidemiological study design.
- 6.2. The candidate will be able to do the following with **sound expertise**:
 - 6.2.1. describe major sampling methods, provide and recognise examples of each method, and compare and contrast the respective strengths and weaknesses of each method.
 - 6.2.2. explain the determinants of sample size and how each affects sample size when:
 - 6.2.2.1. estimating a proportion
 - 6.2.2.2. estimating a mean
 - 6.2.2.3. comparing two independent proportions
 - 6.2.2.4. comparing two independent means
 - 6.2.2.5. detecting disease.
 - 6.2.3. identify examples of potential selection bias, information bias and confounding bias, explain why each identified potential bias may have occurred, discuss the respective impact of each on internal validity and external validity (if applicable), and propose alternate methods for controlling each identified form of potential bias.
 - 6.2.4. identify examples of interaction and interpret results in the presence of interaction.
 - 6.2.5. appraise a questionnaire for potential introduction of information bias and selection bias, and propose appropriate improvements to reduce potential biases.
- 6.3. The candidate will describe the design of an epidemiological study for a given scenario:

- 6.3.1. outline the essential design features of an appropriate epidemiological study (survey, cross-sectional study, case-control study, cohort study or controlled trial)
- 6.3.2. describe and compare alternate options for essential design features where these exist and explain the justification for the choice of particular alternatives.
- 6.3.3. essential features to be included in the outline of the epidemiological study:
 - hypothesis formulation
 - setting objective/s
 - choice of study type
 - unit of study
 - target/reference and study populations
 - defining outcome and exposure variables
 - sampling methods
 - sample size estimation
 - design strategies to minimise bias.

7. Evidence Evaluation

- 7.1. The candidate will have **sound knowledge** of evidence evaluation.
- 7.2. The candidate will be able to do the following with **sound expertise**:
 - 7.2.1. critically evaluate a standard example of each of the following epidemiological studies as reported in a peer-reviewed journal. Evaluation should include the application of learning outcomes from the topics listed above:
 - 7.2.1.1. survey to measure prevalence
 - 7.2.1.2. cross-sectional study
 - 7.2.1.3. case-control study
 - 7.2.1.4. cohort study
 - 7.2.1.5. controlled trial.

8. Description and Analysis of Epidemiological Data

- 8.1. The candidate will have **sound knowledge** of the description and analysis of epidemiological data.
- 8.2. The candidate will be able to do the following with **sound expertise**:
 - 8.2.1. outline the characteristic features of different data types (binary/dichotomous, nominal, ordinal, continuous (interval and ratio))
 - 8.2.2. describe key principles of data management, and recognise examples of inappropriate data management
 - 8.2.3. describe and compare common methods for summarising and presenting each data type, and explain the justification for your preference for particular alternative/s
 - 8.2.4. explain using examples: hypothesis testing, p-values, statistical power, Type I and Type II errors, and interpret specific examples of p-values and statistical power
 - 8.2.5. calculate and interpret confidence intervals for common population measures (proportion/prevalence, mean, odds ratio, relative risk based on attack risk, prevalence ratio, incidence risk ratio, incidence rate ratio)
 - 8.2.6. specify with justification the appropriate parametric or non-parametric statistical approaches when comparing two groups with simple data types and structures (binary/dichotomous, nominal, ordinal, continuous; independent, paired/dependent)
 - 8.2.7. explain the uses and basic concepts of linear regression, logistic regression and survival analysis as tools to analyse data in epidemiological studies, and be able to interpret output from standard examples of each
 - 8.2.8. define hierarchical data and clustering and provide and recognise examples of each.

9. Investigation of Disease Outbreaks

- 9.1. The candidate will have **sound knowledge** of how to investigate disease outbreaks.
- 9.2. The candidate will be able to do the following with **sound expertise**:
 - 9.2.1. undertake a structured investigation of a disease outbreak scenario involving a single farm/enterprise/event and on the basis of this investigation, present a summary of key findings, hypothesis/es regarding cause/s of the outbreak, and recommendations for disease control and prevention and for further investigation.
 - 9.2.2. critically appraise investigations of several disease outbreaks that involved multiple farms/enterprises/events, and specify with justification the respective

strengths and weaknesses of each investigation in terms of attainment of an objective of timely outbreak containment and/or eradication.

9.2.2.1. Essential components to be included in the investigation:

- an explanation of the objectives of various disease outbreak investigations
- case definition
- confirmation that an outbreak is occurring
- creation of an epidemic curve from data provided; incorporate curve into a report with interpretation
- spatial distribution
- attack risk table
- hypothesis formulation
- specification of objective/s for disease control and prevention and further investigation
- definition of trace forward and trace back, calculation of tracing windows and prioritisation of tracing activities.

10. Surveillance and Monitoring

10.1. The candidate will have **sound knowledge** of procedures for surveillance and monitoring.

10.2. The candidate will be able to do the following with **sound expertise**:

10.2.1. describe the various functions of monitoring and surveillance

10.2.2. explain key considerations when interpreting passively collected incidence or prevalence data

10.2.3. provide examples of surveillance activities that contribute to early detection, to evaluation of current regional disease control programs, and to the demonstration of disease freedom for diseases important in Australia or New Zealand selected by the candidate.

10.2.3.1. In these examples, describe the key components of the surveillance activities that contribute to each function.

11. Disease Ecology and Strategies for Disease Control

11.1. The candidate will have **sound knowledge** of disease ecology and strategies for disease control.

11.2. The candidate will be able to do the following with **sound expertise**:

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- 11.2.1. in relation to the occurrence of infectious disease, explain and provide examples of the following concepts:
 - 11.2.1.1. transmission and maintenance of infection in a population of interest
 - 11.2.1.2. methods of spread of disease
 - 11.2.1.3. basic epidemic theory
 - 11.2.1.4. basic reproduction rate (R_0) for infectious diseases
 - 11.2.1.5. herd immunity.
- 11.2.2. list major strategies used for infectious disease control and explain how these affect disease frequency in the context of the concepts above.
- 11.2.3. identify and elucidate the epidemiological features critical to the control and prevention of infectious and non-infectious diseases important in Australia or New Zealand selected by the candidate.

12. Regional Animal Health Programs⁴

- 12.1. The candidate will have **sound knowledge** of regional animal health programs.
- 12.2. The candidate will be able to do the following with **sound expertise**:
 - 12.2.1. describe in detail the objective/s, structure, components and stages of several animal health programs that seek to control and/or eradicate a specific disease from a defined region, and specify with justification the respective strengths and weaknesses of each program in terms of ability to achieve its stated objective/s given known epidemiology of the disease in the region, available resources and other relevant issues
 - 12.2.2. clearly elucidate the differences between control and eradication programs
 - 12.2.3. describe the principles to be considered when embarking on a regional/national disease control program
 - 12.2.4. appraise regional/national disease control and eradication programs
 - 12.2.5. describe social, economic and welfare considerations in disease control programs and provide examples.

13. Risk Analysis

- 13.1. The candidate will have **sound knowledge** of risk analysis.
- 13.2. The candidate will be able to do the following with **sound expertise**:
 - 13.2.1. describe the major steps in undertaking a risk analysis

⁴ The animal health programs referred to in this section are the regional and national animal health programs of Australia and New Zealand.
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13.2.2. outline the key differences between qualitative, semi-quantitative and quantitative risk analysis and the main strengths and weaknesses of the different approaches

13.2.3. apply the principles of risk analysis to many specific scenarios – regional risk analysis; application of biosecurity to regions/localities/individual enterprises/components within an enterprise.

14. Herd Health and Productivity or Performance ('herd' refers to a group of any domestic animals kept or reared together)

14.1. The candidate will have **sound knowledge** of herd health and productivity or performance.

14.2. The candidate will be able to do the following with **sound expertise**:

14.2.1. explain the links between health, productivity or performance and economics for a livestock enterprise

14.2.2. explain, using an example, the process involved in investigating unsatisfactory herd productivity or performance

14.2.3. for specific types of livestock enterprises, specify relevant health and productivity or performance indices and provide examples of how they are used practically

14.2.4. explain how to set and monitor health and productivity targets including critical points for decision making

14.2.5. describe and provide examples of quality assurance systems at the herd level

14.2.6. describe data collection processes for managing herd health and provide an example in an industry nominated by the candidate.

15. Animal Health Economics

15.1. The candidate will have **basic knowledge** of animal health economics.

15.2. The candidate will be able to do the following with **basic expertise**:

15.2.1. explain and give examples of the following economic methods/concepts: partial farm budgets, gross margin analysis, decision trees and payoff tables

15.2.2. describe the key steps and relevant concepts in conducting a cost-benefit analysis of an animal health program.

16. Epidemiological Modelling

16.1. The candidate will have **basic knowledge** of epidemiological modelling.

16.2. The candidate will be able to do the following with **basic expertise**:

- 16.2.1. outline the key differences between different types of disease spread models (e.g. deterministic, stochastic, mathematical, simulation)
- 16.2.2. describe the stages in model development and assessment
- 16.2.3. describe the strengths and weaknesses of commonly used epidemiological models for particular purposes
- 16.2.4. provide examples of applications of commonly used epidemiological models and explain the purposes of these models.

17. Spatial Epidemiology

- 17.1. The candidate will have **basic knowledge** of spatial epidemiology.
- 17.2. The candidate will be able to do the following with **basic expertise**:
 - 17.2.1. describe the components of a geographic information system (GIS)
 - 17.2.2. describe several applications of GIS for epidemiological purposes.

EXAMINATIONS

For information on both the required standard and format for the Written and Oral examinations, candidates are referred to the *Membership Candidates Handbook*. The Membership examination has **two separate components**:

1. **Written Examination (Component 1)**
 - Written Paper 1** (two hours): Principles of the Subject
 - Written Paper 2** (two hours): Applied Aspects of the Subject
2. **Oral Examination (Component 2)**
 - Oral** (one hour)

The written examination will comprise of two separate two-hour written papers taken on the same day. There will be an additional 15 minutes of perusal time for each paper, during which no writing is permitted. For paper 1, you are provided with eight (8) questions to answer, worth 15 marks each, totalling 120 marks for the paper. For paper 2, you are provided with three (3) questions to answer, worth 40 marks each, giving a total of 120 marks for the paper. There is no choice of questions. Questions may be long essay type or a series of shorter answer sub-questions. Marks allocated to each question and to each subsection of each question will be clearly indicated on the written paper. **Non-programmable calculators should be taken to the examination room for both written papers.**

Written Paper 1:

This paper is designed to test the candidate's knowledge of the principles of Veterinary Epidemiology as described in the Learning Outcomes listed above. Answers may include

specific examples to which the general principles apply but should primarily address the theoretical basis underlying each example.

Written Paper 2:

This paper is designed to (a) test the candidate's ability to apply the principles of Veterinary Epidemiology to particular cases/problems or tasks and (b) test the candidate's familiarity with the current practices and current issues that arise from activities within the discipline of Veterinary Epidemiology in Australia and New Zealand.

Oral Examination:

This examination further tests the candidate's achievement of the Learning Outcomes.

Question material will be delivered verbally or with the use of an audio-visual presentation of scenarios or of epidemiological reports/articles.

The candidate will deliver their response to the question with an oral explanation. The duration of this examination is approximately one (1) hour. Four cases/problems or tasks are presented, with each case allocated 25 marks providing a total of 100 marks.

RECOMMENDED READING LIST

The candidate is expected to read widely within the discipline, paying particular attention to areas not part of their normal work experiences. This list of books and journals is intended to guide the candidate to some core references and other source material. Candidates also should be guided by their mentors. *The list is not comprehensive and is not intended as an indicator of the content of the examination.*

Texts

Dijkhuizen AA & Morris RS. *Animal health economics — principles and applications*, chapters 1, 2, 3, 12, 13. Post Graduate Foundation in Veterinary Science, University of Sydney, 1997.

Dohoo IR, Martin SW & Stryhn H. *Veterinary epidemiologic research*. 2nd edn, chapters 1 to 13, 27, 30. VER Inc, Charlottetown, 2009, 895 pp. (Candidates should also refer to any errata as published on www.upei.ca/ver/errata.)

Martin SW, Meek AH, & Willeberg P. *Veterinary epidemiology — principles and methods*. Iowa State University Press, Ames, Iowa, 1987 (ISBN 978-0-8138-1856-6)

Noordhuizen JPTM, Frankena F, van der Hoofd CM & Graat EAM. *Application of quantitative methods in veterinary epidemiology*. Wageningen Pers, Wageningen, 1997.

Petrie A & Watson P. *Statistics for veterinary and animal science*. 3rd edn. Blackwell Science, Oxford, 2013.

Pfeiffer D. *Veterinary epidemiology — an introduction*. Wiley-Blackwell, Chichester UK, 2010. (A good introductory text.)

Thrusfield M. et al. *Veterinary epidemiology*. 4th edn. Wiley, Hoboken, NJ, 2018, 896 pp.

Journals

Australian Veterinary Journal

New Zealand Veterinary Journal

Preventative Veterinary Medicine

Veterinary Record

Internet Resources

Win Episcopa 2.0 (read information about this software program available at <http://www.clive.ed.ac.uk/winepiscopa/>)

EpiTools epidemiological calculators (accessible at <http://epitools.ausvet.com.au>)

Statulator (<https://statulator.com>)

ADDITIONAL RESOURCES

Texts

Altman DG. *Practical statistics for medical research*. Chapman and Hall, London, 1991.

Cameron A. *Survey toolbox for aquatic animal diseases*. ACIAR, Canberra, 2002. Accessible at www.ausvet.com.au/wp-content/uploads/Documents/AquaToolbox.pdf

Cameron A. *Survey toolbox for livestock diseases*. ACIAR, Canberra, 1999. Accessible at www.ausvet.com.au/wp-content/uploads/Documents/Survey-Toolbox.pdf

Cannon RM & Roe RT. *Livestock disease surveys: a field manual for veterinarians*. Australian Bureau of Animal Health, 1982 (ISBN 978-0-644-02101-2).

Geering WA, Roeder PL & Obi TU. *Manual on the preparation of national animal disease emergency preparedness plans*. *FAO animal health manual*, 1999. Accessible at <http://www.fao.org/docrep/004/x2096e/X2096E00.htm#TOC>

Kirkwood BR & Sterne JAC. *Essential Medical Statistics*, 2nd edn, Wiley-Blackwell, Hoboken, NJ, 2012, 512 pp.

Pfeiffer D. et al. *Spatial analysis in epidemiology*. Oxford University Press, Oxford, 2008 (chapters 1, 2 and 3 would be of use to candidates with some experience in GIS software and some understanding of basic geospatial concepts).

Proceedings of International Symposia on Veterinary Epidemiology and Economics 1976 – 2022. Accessible at <https://www.sciquest.org.nz/browse/publications/view/109>

Rothman KL. *Epidemiology: an introduction*. 2nd edn. Oxford University Press, Oxford, 2012.

Rushton J. *Animal Health Economics—an introduction*. CABI Oxfordshire, 2014.

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Salman, MD, editor. *Animal disease surveillance and survey systems — methods and applications*. Iowa State Press, Ames, 2003.

Sargeant, E and Perkins, N. *Epidemiology for field veterinarians: an introduction*. CAB International, CABI Oxfordshire, 2015.

Toma B, & Vaillancourt J, editors. *Dictionary of veterinary epidemiology*. Iowa University Press, Ames, Iowa, 1999, 544 pp.

Journals

American Journal of Epidemiology

Australian Journal of Public Health

Emerging Infectious Diseases

Epidemiology

International Journal of Epidemiology

Scientific and Technical Review (OIE)

Transboundary and Emerging Diseases

Internet Resources

A vast amount of valuable information and software that may be useful is available on the internet, which includes:

Discussion groups and list servers such as EpiVet-L and Promed.

Government and related websites that are directly relevant to veterinary epidemiology (for example, Animal Health Australia, DAFF, the UK DEFRA, New Zealand Ministry of Agriculture and Forestry, US Centers for Disease Control and Prevention).

ANZCVS mentoring guidelines: <https://www.anzcv.org.au/mentoring/>

FURTHER INFORMATION

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