



## AUSTRALIAN AND NEW ZEALAND COLLEGE OF VETERINARY SCIENTISTS

### FELLOWSHIP GUIDELINES

#### *Veterinary Epidemiology*

#### ELIGIBILITY

1. The candidate shall meet the eligibility prerequisites for Fellowship outlined in the *Fellowship Candidate Handbook*.
2. Membership of the College must be achieved prior to the Fellowship examination.
3. Membership must be in Veterinary Epidemiology.

#### OBJECTIVES

To demonstrate that the candidate has sufficient training, experience, knowledge and accomplishment in Epidemiology to be recognised as an authority in this field by his/her colleagues in the veterinary profession.

#### LEARNING OUTCOMES

1. The candidate will have a **detailed**<sup>1</sup> knowledge of:
  1. General concepts and principles of veterinary epidemiology
    - 1.1. History (major events in the evolution of epidemiology), scope and terminology
    - 1.2. Scientific reasoning and logic, methods of inferring causality, formation of a causal hypothesis
    - 1.3. Determinants of disease occurrence, distribution and transmission

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#### <sup>1</sup> 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.

- 1.4. Descriptive epidemiology including measures of disease frequency and occurrence
  - 1.5. Measures of association between determinants and disease outcomes
  2. Design & implementation of epidemiologic studies
    - 2.1. Study design and investigational approaches (including observational, intervention and theoretical studies)
    - 2.2. Calculation of required samples size and statistical power for a study.
    - 2.3. Precision, accuracy, validity, bias and confounding issues
    - 2.4. Study population selection (including: types of sampling strategies, matching, stratification and the impact these have on subsequent analysis).
    - 2.5. Outbreak investigation procedures and methods
  3. Concepts in analytical epidemiology
    - 3.1. Fundamental concepts of statistics and inference from data.
    - 3.2. Comparison of risks and the measures used.
    - 3.3. Addressing systematic error (particularly systematic bias, random error and interaction)
    - 3.4. Hierarchical data and random effects
    - 3.5. Clustering of events in time and space and autocorrelation
  4. Evaluation and interpretation of diagnostic tests
    - 4.1. Gold standard evaluation versus agreement
    - 4.2. Methods for evaluation of diagnostic test performance, including appropriate methods when a gold standard is unavailable
    - 4.3. Interpretation of diagnostic test results and definition of cut-off points
    - 4.4. Strategies for using diagnostic tests at the individual and the herd level
    - 4.5. Clinical epidemiology and decision-making
  5. Data collection, organisation and management
    - 5.1. Uses and limitations of data collection methods
    - 5.2. Use of computers to collect and manage large data sets (large numbers of records and large numbers of variables). Includes validating the integrity of data, correcting errors, handling missing data and descriptively analysing a data set and presenting the results.
    - 5.3. Data types and implications for data collection and analysis
  6. Surveillance and disease control and eradication
    - 6.1. Types, design and implementation of surveillance systems and surveys
    - 6.2. Principles for design of disease control and eradication programs
    - 6.3. Syndromic surveillance and other data sources.
2. The candidate will have a **sound** knowledge of:
1. Statistical methods for epidemiological analysis
    - 1.1. Principles of statistical theory (sampling distributions, central limit theorem, confidence intervals, statistical hypothesis testing and interval estimation)

- 1.2. Statistical (alpha and beta) errors
- 1.3. Parametric versus non-parametric methods, and traditional versus Bayesian approaches to analysis
- 1.4. Statistical model implementation including appropriate models and model building (e.g. causal web diagrams, information theoretical approaches, automated approaches)
- 1.5. Assumptions, assessing model fit and statistical model checking
- 1.6. Choice of statistical method given study design and data types. NOTE: Candidates will be expected to be able to identify an analytical approach suited to a specific problem presented to them. Candidates will need to understand the virtues and limitations of each of the major analytical approaches in widespread use in epidemiology, without necessarily being experienced in applying more than a proportion of them. Examples include exploratory data analysis; categorical data analysis, various forms of regression especially those involving multiple predictor variables and those with greatest application in epidemiology (least squares regression, logistic regression and proportional hazards regression). Candidates should be familiar with models for fixed and random effects, and understand the application of Bayes theorem and latent class analysis. The techniques mentioned throughout the text by Doohoo, Martyn and Stryhn provides a good indication of the analyses that candidates should be familiar with.
- 1.7. Ecological studies and analytical and inferential concepts applied in such studies
2. Principles of animal health economics
  - 2.1. Understanding the difference between, and application of, concepts in micro and macro economics in veterinary epidemiology, and financial versus economic analysis
  - 2.2. Application of economic evaluation methods in animal health (for example, benefit-cost analysis, linear programming and input/output analysis)
  - 2.3. Data gathering for methods commonly applied in economic analyses
  - 2.4. Approaches for incorporation of intangibles and indirect costs and benefits in economic analysis
3. Risk assessment and management
  - 3.1. Principles of risk management
  - 3.2. Animal trade/movement and disease risk
  - 3.3. International disease reporting (OIE)
  - 3.4. Import risk analysis (IRA) including WTO, SPS and OIE guidelines for IRA.
  - 3.5. Types of risk assessment, including qualitative and quantitative. Scenario models. Use of stochastic models. Understanding of variability and uncertainty. Deriving model parameters from data. Import risk assessment.

4. Disease spread modelling
    - 4.1. Types of models – deterministic and stochastic; types of mathematical, computation and logical approaches to modelling
    - 4.2. Steps in model building
    - 4.3. Model validation and evaluation
    - 4.4. Use of models to represent disease occurrence and options for disease control
  5. Epidemiological design of animal health and productivity programs
    - 5.1. Principles of animal health and productivity programs design and implementation
    - 5.2. Concepts of voluntary disease control and eradication campaigns
    - 5.3. Examples of regional animal health programs and animal health information systems
  6. Human health and environmental implications of animal disease
    - 6.1. Ecosystem health, zoonotic disease risk and the One Health approach
    - 6.2. Management of animal health and production systems to reduce human health risk associated with zoonotic diseases
    - 6.3. Food safety and food safety risk assessment, focusing on on-farm and abattoir interventions
  7. Epidemiology of important diseases relevant to Australia and New Zealand
    - 7.1. These are the diseases that are of major importance from a national economic viewpoint, major notifiable diseases, major zoonotic diseases, and diseases with a large impact on animal welfare.
    - 7.2. Causal factors, transmission, infection reservoirs, control methods of endemic, exotic and zoonotic diseases, particularly those that are notifiable or under active control and/or eradication programs
  8. Evidence based medicine
3. The candidate will have a **basic** knowledge of:
1. Other statistical methods less frequently used by epidemiologists (for example, principal component analysis)
  2. Spatial methods commonly used in epidemiologic data analysis and an understanding of clustering and disease clusters
  3. Development and management of veterinary services, including principles of project management, program management, information management and decision support systems. Assessment of veterinary services.
  4. Infectious disease concepts and analytical methods (including  $R_0$  estimation, herd immunity)
  5. Policy development for animal health
  6. Concepts in animal demographics
  7. A range of related and new topics, for example
    - 7.1. molecular epidemiology
    - 7.2. environmental epidemiology

- 7.3. meta-analysis
  - 7.4. social network analysis
  - 7.5. emerging infectious disease epidemiology
  - 7.6. epidemiological methods for diseases of wildlife.
4. The candidate will **be able to:**

**Detailed<sup>2</sup> expertise**

1. Creating and managing a computerised data base to hold a large volume of data typical of that generated from a substantial epidemiological study.
2. Evaluating the integrity of a data set by using commands or formulae to search for irregularities, illegal values and inconsistencies.
3. Create hypotheses based on scientific reasoning and design epidemiologic studies
4. Perform data analysis in a repeatable and auditable manner such that the integrity of the original data is preserved. To satisfy this it is essential that candidates acquire skills in one of the recommended statistical software packages (see below).
5. Extraction of descriptive information (e.g. summary statistics) from data sets and presentation in appropriate graphical and tabular formats.
6. Prepare a data set for sophisticated statistical analysis by manipulating the organisation and format of data to satisfy the requirements of whatever routine is being applied.

**Sound expertise:**

1. Perform a range of statistical tests – including univariable and multivariable – and interpret results given statistical assumptions
2. Interpret the results of economic studies in animal health
3. Advise on studies for risk assessment and interpret the results of such studies
4. Determine the circumstances in which disease spread models should be used and provide advice on how to create, validate and use such models
5. Design animal health and productivity programs and studies addressing zoonotic and ecosystem health issues
6. Identify the critical issues of important diseases relevant to Australia and New Zealand

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<sup>2</sup> **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.

7. Scientific writing for the purposes of publication in peer-reviewed journals or for reporting the findings of an epidemiological study to a government or industry body.
8. Professional presentation of reports and manuscripts, including suitable formatting of documents, correct use of citations, production of publication-ready plots and tables to communicate epidemiological findings.
9. Making oral presentation of findings of epidemiological studies to epidemiologists, other scientists and interested parties.

**Basic** expertise:

1. Advise on when specific statistical methods should be used in epidemiology
2. Elementary computer programming that can include the use of macro-languages for spreadsheets or scripting code for statistical packages
3. Approaches in collecting and analysing spatial information
4. Describe the critical steps in implementation of project and program management and information management and decision support systems, and assessment of veterinary services
5. Describe how policy can be developed in animal health
6. Given assumptions, estimate  $R_0$  and herd immunity

## EXAMINATIONS

Refer to the *Fellowship Candidate Handbook*, Section 5. The Fellowship examination has **four separate, autonomous components**:

1. **Written Paper 1** (*Component 1*) (four hours)
2. **Written Paper 2** (*Component 2*) (four hours)
3. **Practical Examination** (*Component 3*) (three hours)
4. **Oral Examination** (*Component 4*) (two hours)

The written examination will comprise of two separate four-hour written papers taken on two consecutive days. There will be an additional 20 minutes perusal time for each paper, during which no writing in an answer booklet is allowed. In each paper you are provided with four (4) questions worth 60 marks each, providing a total of 240 marks. There is no choice of questions. Questions may be long essay type or a series of small sub-questions. A formula sheet will be provided and all steps in calculations are to be shown. Marks allocated to each question and to each subsection of questions will be clearly indicated on the written paper.

**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.

**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.

The examinations will focus on how the candidate would approach particular types of problems and tasks, using a range of skills and knowledge of veterinary epidemiology.

**Practical Examination:**

Clinical and Practical

The candidate will be given a set of problems including design issues and epidemiological data for analysis and interpretation. The candidate will be expected to describe, analyse and report on one or more of the data sets provided. The examination will be structured to take between 1-2 hours to complete, although candidates will be allowed up to 3 hours maximum if requested. The candidate will be expected to provide the following in the written report:

- \* Descriptive analysis
- \* Bivariate analysis
- \* Exploration of potential confounding
- \* Implementation and interpretation of generalised linear models on simple datasets
- \* A proposal for further in-depth analysis

No perusal time will be given for the practical exam. The practical will consist of a series of four questions with sub-questions, equating to a total of 120 marks. Marks allocated to each question and to each sub-section will be clearly indicated on the written paper.

The candidate will provide their own computer for use during the examination. It should be pre-loaded with appropriate software capable of conducting statistical analysis. The report should be produced using a word-processing program and saved to an external USB stick, printed or provided as a handwritten report with reference to printed or saved figures and tables. A printer will be available to produce the report, if required, and to print results of statistical analyses. A USB stick will be provided.

## **Oral Examination:**

The oral examination is designed to test practical aspects of the Learning Objectives. Six (6) questions are presented with supporting information asked verbally in a face-to-face setting. The oral examination has a total of 120 marks with each question allocated 20 marks.

## **TRAINING PROGRAMS**

Refer to the *Fellowship Candidate Handbook*, Section 2.

## **EXTERNSHIPS**

Refer to the *Fellowship Candidate Handbook*, Section 2.4.1.

## **TRAINING IN RELATED DISCIPLINES**

Refer to the *Fellowship Candidate Handbook*, 2.4.2.

## **ACTIVITY LOG SUMMARY**

The Activity Log Summary (ALS) must be recorded throughout supervised training in the primary discipline. An example of an Activity Log Summary Entry is included in Appendix 1.

The objective of the Activity Log Summary is to demonstrate diversity in the types of activities in which candidates are involved. Candidates should strive to get experience across a wide range of epidemiological techniques and issues and avoid being too focused on just a few areas. Due to the nature of epidemiological work it is expected that candidates will only report on 10-15 activities during their training period, however these activities should be classified by each of the following categories in the Activity Log Summary:

- Animal Species and Type (production animal, companion animal, wildlife)
- Study Type (for example, outbreak investigations, descriptive epidemiology, observational studies, herd health program, disease control, etc)
- Techniques used (for example, non-analytic or descriptive report, univariate & bivariate analyses, multivariate analyses – indicate specific analytical approaches, risk analysis, simulation modelling)
- Role (describe your role in this activity)
- Learning outcomes addressed (list number)

The Activity Log Summary will provide the Chapter Examination Committee (CEC) with a realistic appraisal of the diversity of activities being undertaken by the candidate during the training period. Published papers and reports are one method of demonstrating satisfactory completion of the required activities. Other categories that might be included are consultancies and technical reports, courses attended and other training completed, research grant proposals written or awarded, conference presentations.



## RECOMMENDED READING LIST

### List of Suggested Information Sources and Software

The candidate is expected to research the depth and breadth of knowledge in Epidemiology. The list is intended to guide the candidate to some core references and source material. The list is not comprehensive and is not intended as an indicator of the content of the examination. Books are regularly updated and the most current edition should be sourced.

#### Texts Books and Proceedings

1. Collett D. 2002. 2<sup>nd</sup> edition. Modelling binary data. Chapman and Hall, London. 408pp.
2. Collett D. 2003. 2<sup>nd</sup> edition. Modelling survival data in medical research. Chapman and Hall, London. 408pp.
3. Dohoo I, Martin W and Stryhn H. Veterinary Epidemiologic Research, 2010. 2<sup>nd</sup> edition. VER Inc, Prince Edward Island, Canada 865pp.
4. Hosmer DW, Lemeshow S. 2000. Applied logistic regression, 2<sup>nd</sup> Edition. Wiley, New York 373 pp.
5. Hosmer DW, Lemeshow S and May S. 2008. 2<sup>nd</sup> edition. Applied Survival Analysis: Regression Modeling of Time to Event Data. Wiley-Interscience. 416pp.
6. Hudson PJ, Rizzoli A, Grenfell BT, Heesterbeek H, Dobson AP. 2002. The Ecology of Wildlife Diseases. Oxford University Press, USA 240pp.
7. Keeling MJ and Rohani P. 2007. 1<sup>st</sup> edition. Modeling Infectious Diseases in Humans and Animals. Princetown University Press. 408pp.
8. Kleinbaum DG, Kupper LL, Muller KE. 2007. 4<sup>th</sup> edition. Applied Regression Analysis and other Multivariate methods. Duxbury Press. 928 pp
9. Proceedings of the International Society for Veterinary Epidemiology and Economics: (these conferences are held on a triennial basis with).
10. Rothman KL, Greenland S and Lash TL 2008: Modern Epidemiology. 3rd edition. Lippincott-Raven Publishers, Philadelphia PA 851 pp
11. Sackett L, Haynes RB, Guyatt GH, Tugwell P. 1991; Clinical Epidemiology - a basic science for clinical medicine. 2nd edition. Little, Brown and Company, Boston, 441pp.
12. Salman M (ed). 2003. Animal Disease Surveillance and Survey Systems: Methods and Applications. Wiley-Blackwell New York 222 pp.
13. Stevenson M, Stevens KB, Rogers DJ, Clements ACA, Pfeiffer DU and Robinson TP. Spatial analysis in epidemiology. 2008. Oxford University Press 208 pp.
14. Selvin S. 1995. Practical Biostatistical Methods. Wadsworth Publishing Company, Belmont CA 520 pp
15. Thrusfield, M. (2007) Veterinary Epidemiology, Wiley.

### **Recommended reading - journals**

1. Preventive Veterinary Medicine
2. National veterinary journals (such as the Australian Veterinary Journal, New Zealand Veterinary Journal)

### **Other relevant journals**

1. American Journal of Epidemiology
2. International Journal of Epidemiology
3. Epidemiology
4. Australian Journal of Public Health
5. Emerging Infectious Diseases
6. Statistics in Medicine
7. Journal of Clinical Epidemiology
8. Transboundary and Emerging Diseases

### **Internet resources**

Candidates should be aware of the vast amount of valuable information that is available on the internet, including:

- Discussion groups and list servers such as Promed and EpiVet-L
- Government and related websites that are directly relevant to veterinary epidemiology (for example, Animal Health Australia, the UK DEFRA, New Zealand Ministry of Agriculture and Forestry, US Centers for Disease Control and Prevention)

### **Software useful for epidemiological research.**

A wide range of software is available for data management, statistical and graphical analysis, report writing and presentation. These programs are very useful tools for veterinary epidemiologists and candidates are expected to have skills in this area. While software experience is important, candidates should note that they are also expected to understand the key principles behind their use.

Candidates should have experience with the use of one or more major statistical software programs (such as SAS, SPSS, S-Plus, STATA, R etc).

## **FURTHER INFORMATION**

For further information contact the College Office

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## APPENDIX 1

### ACTIVITY LOG SUMMARY – VETERINARY EPIDEMIOLOGY

DATE(S)	*CATEGORY e.g. species, organ system, type of activity	ANIMAL/HERD DETAILS	PROBLEM DEFINITION	PROBLEM SOLVING AIDS	SOLUTION PROPOSED	OUTCOME	**INITIALS
Jan.–Mar. 2015	Cattle	Various – NSW, Vic	Poor reproductive rates	Case-control study	Control based on risk factors identified, including nutrition	Publication, AVJ	
May–July 2015	Cattle, sheep	Australia	Import risk analysis	Risk assessment	Risk minimization procedures	Technical report, AHC	
Feb.–May 2015	Equine	Racing stables, Flemington	Outbreak investigation – respiratory disease	Cases series, Case-control study	Ongoing surveillance	Presentation AAEVP	
Aug.–Dec. 2015	Pigs	Australia	Exotic disease incursion and spread	Disease spread modelling	Expert opinion + disease spread model parameterization	Submission of research proposal – Australian Pork Limited	
Apr. 2015	Non-specific	N/A	Analytical epidemiology	Logistic regression short course	N/A	Course completed	