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Preparing for Membership Exams in Epidemiology: A study guide for groups

Australian College of Veterinary Scientists

This study guide is intended for groups of candidates studying for Membership in the Australian College of Veterinary Scientists, by examination in Epidemiology. Individuals studying for Membership exams may also find this guide useful in monitoring progress in their own study programs. This guide is an updated and revised version of the guide dated March 1998, which was compiled by Victorian candidates of 1996/97 led by John Morton and Norm Anderson.

Cameron Bell, Zoe Cannon, Katherine Clift and Mark Stevenson have produced this updated and revised information using information from their respective study groups, which undertook the Epidemiology examinations in 2005.

We would like to thank John Morton, Andrea Britton, Tracey Bradley, Peter Mansell, Ben Madin, Sam Beckett, John Weaver and Evan Sergeant for reviewing the guide and providing valuable feedback.

If you have any comments, suggestions, erratum to report etc then please contact Zoe Cannon zoe@tvg.com.au or Cameron Bell Cameron.Bell@dpiwe.tas.gov.au. We are keen to receive any feedback that will assist to improve the study guide for future groups

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Benefits of studying in groups

Developed originally by Andrew Kelly, revised by Katherine Clift and John Morton.

Preparing for examination in groups has a number of advantages over individual preparation. In a group, some parts of the workload can be shared. Group membership encourages a steady, consistent pace of learning. Group members can learn from the experiences of others in the group as issues tend to be viewed from different perspectives by different people. Group discussions can help members understand concepts. Groups are a great way to get to know other vets with similar interests.

Using this guide

In general, it is recommended that candidates and groups prepare over 16 - 18 months. This study guide assumes that preparation begins in February with written and oral examinations undertaken in June and July, respectively, of the following year.

The topics suggested for study in this guide should be viewed only as a general recommendation. Not all 'potentially examinable' areas are addressed in this program. In addition, each candidate and each group will have particular requirements that should be addressed where appropriate during the course of study. ***So candidates and groups are strongly advised to use this document only as a guide. Material and issues covered should be modified after considering both the topics listed in the Epidemiology section of the 'Guidelines for Membership Candidates' and the particular requirements of individuals and groups.***

This amendment process needs to be considered on an ongoing basis during the preparatory period. Although many of the concepts/topics may be covered in a number of meetings there are no specific revision sessions. If the group is struggling with particular concepts then additional sessions may be required. It may also be advisable to have additional group revision sessions prior to the examinations.

Readings are listed for each topic. There are also suggestions for additional reading/resources. However, there may be more appropriate sources. So participants should view the reading only as a suggested starting point. In addition, general reading is recommended in the Guidelines for Membership Candidates.

Other useful sources of information during the preparation process

Mentors and other helpers

Personal assistance is desirable during preparation. Intending candidates can request that the College appoint a mentor to assist during their preparation period. Other current members of the Epidemiology Chapter can also be approached for help.

Guidelines for Membership Candidates

'The Red Book' provides general advice on preparation for membership examination. The 'Membership guidelines Epidemiology' provides the information required for candidates to be examined in Epidemiology. Candidates should ensure that they obtain the most recent draft of these guidelines. 'The Red Book' was last amended in 2005 and the 'Membership guidelines Epidemiology' in 2001. This study guide should be read in conjunction with these guidelines. These guidelines are available from the Australian College of Veterinary Scientists Website http://www.acvs.org.au/.

Past examination papers

Past examination papers for Membership in the Australian College of Veterinary Scientists, by examination in Epidemiology are available from the Australian College of Veterinary Scientists Website http://www.acvs.org.au/.

Suggested learning activities as part of the group process

Before commencing the study meetings it may be useful to have an initial meeting to develop a plan for the sessions. It may be based on those plans shown in this guide but should be amended to suit particular needs.

The items that may be covered in the preliminary meeting include:

- When and where the meetings should occur
- What duration and structure the meetings might have
- What people would like to get out of the group eg undertake exams or improve knowledge without being examined
- Appointment of a group coordinator(s)
- Identification of group mentors/assistants
- Identification of potential guest speakers or people with special expertise
- Setting of ground rules eg respect for all participants, punctuality etc
- Sourcing of required reading and journal articles/other resources

This preliminary meeting also provides an opportunity to gauge the level of interest and allow people to meet each other.

Some meeting plans will take less time than others. When arranging meetings, groups may wish to combine some plans suggested in this guide. Ideally, meetings should be planned to take approximately 5 - 6 hours including a break. It is difficult to cover topics adequately with meetings of less than 4 hours.

A number of distinct learning activities have been included in this guide for each meeting.

Prescribed minimum reading before group meetings

Prescribed reading should adequately cover required subject matter but extra reading should also be considered.

In this guide, Dohoo and Thrusfield are frequently recommended reading sources. These sources cover similar material for many topics. However, for some topics, there are other texts listed. There may be some duplication with readings. However, this was done because different candidates may prefer the different presentation styles.

Additional resources/reading

There is a wealth of information available on many of these topics, the additional resources/reading is designed to give you a guide as to where to start looking if you require more information on a topic or are seeking a different presentation style to assist your understanding.

Presentations at group meetings

Topics are generally subdivided into a number of presentations. Each of the previously nominated participants should be asked to present a short summary of the key points of one presentation.

The aims of presentations are to:

- introduce the subject matter and stimulate group discussion,
- highlight key and confusing points, and
- Provide a complete list of the key points.

It is suggested that each presenter prepare a brief (1 - 2 page) summary of their nominated presentation for circulation to candidates at the meeting. The presenter is not expected to be an expert on their part of the topic. Rather they should have simply made an attempt to identify all key issues and points.

Exercises

Relevant exercises are useful to both increase technical understanding and to improve examination technique. Within 3 months prior to written examinations, these problems could be attempted under 'real-life' written exam conditions.

Review papers

Reviewing papers is not an attempt to 'pull a paper to bits'. It is based on the concept that virtually all published papers can make some contribution to knowledge, but that many papers have some limitations which must be identified to place the paper's usefulness into perspective. The emphasis is on identifying areas in which a paper could have been improved, and on interpretation of study results using epidemiological skills.

Previous exam questions

Relevant exam questions from previous years have been included in each meeting. These provide a guide as to the depth and breadth of knowledge required on this topic. Many of the exercises require you to undertake one or more of the previous examination questions. The examination format used by the college and the style of the questions may change significantly from one exam to the next so please use the questions only as a guide to learning.

Role of group assistants and group mentors

The key role group assistants or group mentors is to recommend reading, to suggest presentation areas, to present problems and to identify papers for review. They should also attend some group meetings, but should not be required to lead meetings. It is suggested that group assistants or mentors do not lecture on specific topics nor accept the task of presenting, even for topics in which they are particularly expert. Participants will learn much more by being the presenter than by being presented to. (See below under 'Key characteristics of successful groups'.)

Expertise for particular topics

Experts in various areas on epidemiology should be identified and use made of their expertise to assisting achieving learning objectives. Benefit from experts is maximised if candidates complete some preparatory reading before the meeting and if some interaction is possible during the meeting. So experts should be requested to suggest reading (and perhaps presentation topics and problems) well before the meeting.

Key characteristics of successful groups

Some study groups in epidemiology are more successful than others. There appear to be some important characteristics that contribute to the success of groups as a learning method.

A common goal

Participants should define their expectations and targets early in the group's formation. Group success is more likely when participants have a common purpose. The simplest situation is where all candidates are aiming to gain membership in the same year. However, in some groups, participants have had varied aims (eg participants aiming for membership in different years or some participants aiming to improve their epidemiological knowledge without attempting membership while others in the same group are committed to attempting membership examinations). Also, some participants may need to begin the process before they are able to decide whether to attempt membership examinations. Groups can be successful in these situations provided there is adequate commitment to the learning process of the group by all members, regardless of their individual aims.

Attitudes

It is important that candidates take responsibility for their own learning. As such, the degree of success of the group process is in their hands.

This attitude may be reflected in:

- Candidates (rather than group assistants or mentors) chairing the group meetings
- Group assistants or mentors delivering very few, if any, presentations
- Candidates (rather than group assistants or mentors) taking responsibility for organisational issues (ie venue arrangement, circulating meeting details, providing copies of relevant papers for absent group participants etc)

Commitment to the group

The group process depends on reasonable commitment from all members. This is reflected in presenters being prepared, members having completed the prescribed reading, getting to meetings on time etc. As the group process is quite time consuming, preparation and meeting time must be successfully balanced with the many other demands on each participant's time.

Interactive learning style

One of the key benefits of group learning over individual preparation is the interaction. Accordingly, groups should avoid excessive 'lecture' style approaches. The most useful presentations are those that move through a planned body of material but with ample opportunity for questions and discussion during as well as after the presentation.

Participation by all members at all meetings

Learning is generally more focussed for those having a specific task at the next meeting. Accordingly, it is desirable that each group member is allocated a task before each meeting. These tasks might include doing a presentation, leading discussion about a problem or exercise, or commenting on a review paper.

Atmosphere

Learning is enhanced in an uncritical atmosphere. It is important that people feel comfortable about 'thinking out loud', expressing uncertainties, exploring topics, making mistakes and taking time to grasp new concepts. All group participants must feel comfortable about stopping the group from moving on until they have understood an issue.

Group coordinator

It is highly desirable necessary to have one person take on the role of group co-ordinator. This person should ensure that organisational issues are addressed. These issues include arranging meeting rooms, circulating meeting plans, allocating tasks to group members, ensuring that prescribed reading is available to all members and ensuring that absent members receive notes etc from missed meetings. This role could be rotated during the preparation period.

Group size

Groups can be either too small or too large. It may be difficult to get a broad range of backgrounds and perspective's with a very small group. Stimulating discussion may be more difficult to encourage. Discussion can also be restricted in large groups where a more formal atmosphere seems to predominate. Individuals may be less likely to raise concerns in a large group. The ideal group size would appear to be between 4 and 6 committed participants.

Examples and references used in this guide

Many examples used in this guide are hypothetical or are based on 'real-world' data but with extensive modifications. Please don't assume that any of these examples reflect actual observations or data except where this is stated.

Journal articles are referenced in the usual fashion.

Problems cited as year and question number are questions from past examination papers for Membership in the Australian College of Veterinary Scientists, by examination in Epidemiology.

The following texts have been cited in the suggested reading:

Texts referenced frequently that should be acquired by each candidate:

- Dohoo I, Martin W, Stryhn H. Veterinary Epidemiologic Research. AVC Inc, Charlottetown, ISBN 0-919013-41-4, 2003.
- Thrusfield M. *Veterinary Epidemiology.* 2nd edition, Blackwell Science Ltd, Oxford, ISBN 0-632-04036-X, 1995 or 3rd edition, Blackwell Science Ltd, Oxford, 2005.
- Cameron A. *Survey Toolbox – A practical manual and software package for active surveillance of livestock disease in developing countries*. Australian Centre for International Agricultural Research, 1999. Also available from http://www.ausvet.com.au/resources/LiveToolbox(en).pdf
- Sergeant E, Cameron A, Baldock C. *Epidemiological Skills for Animal Health Professionals Volume 2: Epidemiological Problem Solving*. Aus Vet Animal Health Services, Brisbane ISBN 0-9579698-2-1, 2004. Purchase through Ausvet http://www.ausvet.com.au/.

Texts referenced less frequently that the group should have access to:

- Toma B, Dufour B, Sanaa M, Benet J-J, Ellis P, Moutou F and Louza A (1999). *Applied Veterinary Epidemiology and the control of disease in populations* Maisons-Alfort, France.
- Dijkhuizen AA and Morris RS (1997). *Animal Health Economics: Principles and Applications.* PGFVS, University of Sydney.
- Pfeiffer DU (1997) Decision making and risk analysis. In R.Ruppanner (ed.) *Risk Analysis and Animal Health - A Course Manual.* International Training Course, Dübendorf, Switzerland, July 13-18. Available: http://www.vetschools.co.uk/EpiVetNet/risk_analysis.htm
- Petrie A and Watson P (1999). Statistics for Veterinary and Animal Science, Blackwell Science Ltd. Oxford.

SUGGESTED PROGRAM FOR MEETINGS

CAUSATION

Feb Meeting 1: Overview of epidemiology, causation

DISEASE ECOLOGY AND DESCRIPTIVE EPIDEMIOLOGY

March Meeting 2: Patterns of disease

April Meeting 3: Measures of disease frequency and association

May Meeting 4: Outbreak investigation

FUNDAMENTAL EPIDEMIOLOGICAL PRINCIPLES

June Meeting 5: Sampling

July Meeting 6: Use of diagnostic tests and procedures

August Meeting 7: Bias, interaction

EPIDEMIOLOGICAL STUDIES

September Meeting 8: Observation studies 1

October Meeting 9: Observational studies 2

November Meeting 10: Intervention studies

December Meeting 11: Questionnaires, data management, and data analysis 1

January Meeting 12: Data analysis 2

February Meeting 13: Data analysis 3

POPULATION-BASED APPLICATIONS

March Meeting 14: Herd health, disease control and eradication programs

April Meeting 15: Modelling and Risk Analysis

May Meeting 16: Economics

REVISION

June Meeting 17: Final revision

July Meeting 18: Preparation for oral examination

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Meeting 1: Overview of epidemiology, causation

Reading

- Dohoo Chapter 1.1-1.4 (history and overview); 1.5-1.10 (causation)
- Thrusfield 2nd or 3rd Edn, Chapter 1 and 2 (history and overview); Chapter 3 (causation)
- http://www.epidemiolog.net/evolving/HistoricalPerspective.pdf

Presentations

1. The meaning and scope of epidemiology
2. Judgement criteria for assessing causality (discuss how they have changed with history)
3. Causal models (indirect and direct causes, necessary and sufficient causes, causal webs, path analysis)
4. John Snow – a brief history of his work. What judgment criteria did he use in his work with cholera (see Eyler JM. 2001. The changing assessment of John Snow's and William Farr's cholera studies. Soz Preventiv Med, 46(4): 225-232. Available: http://www.epidemiology.ch/history/papers/eyler-paper-1.pdf)

Exercises

1. Judgement criteria for causality

   There have been several outbreaks in cattle of a severe hepatopathy with high incidence and sometimes, high case fatality rate. The hepatic damage is apparently quite distinctive histologically. There is some speculation that the disease is due to ingestion of a weed known as Rough Dog's-Tail (*Cynosurus echinatus*).

   List the judgement criteria for causality.

   The following pieces of information have progressively accumulated. Which judgement criterion does each piece contribute to? How useful is each piece of information for determining causality?

   i. In the first fully investigated Victorian outbreak, Rough Dog's-Tail (RDT) was available and eaten by cattle in the affected mob.

   ii. In 2 subsequent outbreaks in Victoria, RDT has been available to cattle although it has not always comprised a large proportion of available pasture.

   iii. In a series of 10 Tasmanian outbreaks, cattle and sheep in all outbreaks have had access to RDT.

   iv. The hepatopathy has only been reported in areas where RDT exists.

   v. The frequency of diagnosis of the hepatopathy has increased as the habitat of RDT has expanded.

   vi. In a case-control study, apparently toxic paddocks were substantially more likely to contain RDT than apparently safe paddocks (OR = 5.1).

vii. In a 4 year cohort study, paddocks containing RDT were more likely to result in outbreaks than paddocks not containing RDT (RR = 3.6)

viii. In the same cohort study, the proportion of available pasture that was RDT in each paddock was categorised as nil, 1-50% and > 50%. The risk of an outbreak was greater in heavily infested paddocks (RR = 2.1 and 4.9 for 1-50% and > 50%, respectively).

ix. Chemical analysis of RDT has revealed low levels of a known hepatotoxin in some samples.

x. Feeding RDT to rats caused a mild hepatic disease.

xi. (Note: Pieces i to iv are actual observations. The remaining pieces are hypothetical.)

2. Draw a hypothetical causal web for a multifactorial disease or production deficit that you are familiar with.
3. Read the paper 'Cancer incidence and mortality and proximity to TV towers' and discuss how it addresses the criteria for causation. The paper can be found at: http://www.mja.com.au/public/issues/contents165.html#2Dec. After you have done this read the article (at the same site) 'Cancer and TV towers: association but not causation'. Discuss this article with other group members.

Example examination questions

1. Briefly describe the essential features and application of path models for causation (2003 written)
2. Write brief notes to demonstrate your understanding on the criteria for judging causal relationships in epidemiological studies (2002 written)
3. Using examples write brief notes on establishing a causal relationship (2001 written)
4. Using examples write brief notes on necessary and sufficient cause (2000 written)

Additional reading/resources

- http://ww.epidemiology.ch/history/epi-hist.htm (many articles on the history of epidemiology)
- Austin Bradford Hill (1965) The Environment and Disease: Association or Causation? Proceedings of the Royal Society of Medicine, 58: 295-300. Available: http://www.edwardtufte.com/tufte/hill
- Chesterton RN, Pfeiffer DU, Morris RS and Tanner CM (1989) Environmental and behavioural factors affecting the prevalence of foot lameness in New Zealand dairy herds – a case-control study. NZ Vet J, 37: 135-142.
- http://ww.ph.ucla.edu/epi/snow.html a site dedicated to John Snow

Meeting 2: Patterns of disease

Reading

- Thrusfield 2nd Edn or 3rd Edn Chapter 5 (Determinants of disease)
- Thrusfield 2nd Edn or 3rd Edn Chapter 6 (Transmission and maintenance of infection)
- Thrusfield 2nd Edn or 3rd Edn Chapter 7 (The ecology of disease)
- Thrusfield 2nd Edn or 3rd Edn Chapter 8 (Patterns of disease)
- Thrusfield 2nd Edn, pp 54-59 or 3rd Edn pp 67-74 (mapping)

Presentations

1. Methods of disease transmission and maintenance of infectious diseases with examples
2. Host factors and disease occurrence with examples
3. Use of geographical information systems with examples of their application to animal health
4. Patterns of disease in time

Exercises

1. Discuss and analyse the factors that have contributed to the development of emerging diseases and their importance eg SARS, avian influenza, Nipah, West Nile virus or another topical disease
2. Discuss the Reed-Frost model – application, advantages and limitations
3. Example examination question 1. Need to consider:
    - Occurrence (time, space and population),
    - Cause (agent characteristics, host factors, environmental factors), source,
    - Susceptibility
    - Transmission (effective contact),
    - Cost
    - Control management or eradication options

Example examination questions

1. Select a topical disease for three (3) of the four options below. Explain how features of the epidemiology of each disease you have selected are relevant to its control, management or eradication
    a. A food-borne zoonotic disease of wildlife or companion animals
    b. A parasitic disease of wildlife or companion animals
    c. A congenital disease of animals

   d. A viral disease of production animals (2005 written)

2. Briefly describe the essential features and application of
   a. Time series analysis
   b. Geographic information systems (2003 written)
3. Briefly describe the essential features and application of Reed-Frost models (2002 written)
4. Write brief notes to demonstrate your understanding of herd or population immunity
5. Using examples, write brief notes on methods of disease transmission (2002 written)
6. Write brief notes to demonstrate your understanding of temporal patterns of disease (2001 written)

Additional reading/resources

- Sergeant et al. (2004) Epidemiological problem solving, Ausvet Series in Epidemiological Skills for Animal Health Professionals, pp 25-29
- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 161-175 (ecology of disease), pp 239-254 (patterns of disease)
- McGinn et al (1996) Geographic information systems for animal health management and disease control. JAVMA 11(1): 1917-1921.
- Sanson et al. (1991) Geographic information systems: their application in animal disease control. Rev. sci. tech. Off. int. Epiz. 10(1): 19-195.
- Jackson et al. (2005) Epidemiology of the 2003-2005 Epidemic of Avian Influenza H5N1 in Asia. In: Proceedings of the Food Safety & Biosecurity and Epidemiology Branches of the NZVA, pp 87-99.
- Daszak P, Cunningham AA and Hyatt AD (2000) Emerging Infectious Diseases of Wildlife – Threats to Biodiversity and Human Health. Science, 287(5452): 443-449.
- Morse SS (1995) Factors in the Emergence of Infectious Diseases. EID 1(1). Available: http://www.cdc.gov/ncidod/eid/vol1no1/morse.htm
- 'Global Aspects of Emerging and Potential Zoonosis: a WHO perspective' Available: http://www.cdc.gov/ncidod/eid/vol3no2/meslin.htm

Meeting 3: Measures of disease frequency and association

Reading

- Dohoo et al, pp 65-76 (disease frequency); pp 121-130 (measures of association); pp 76-81 (standardisation)
- Thrusfield, 2nd Edn, pp 37-47 or 3rd Edn pp 46-64 (disease frequency)
- Thrusfield, 2nd Edn, pp 224-229 or 3rd Edn, pp 269-273 (measures of association)
- Thrusfield 2nd Edn pp 49-53 or 3rd Edn pp 63-64 (standardisation)

Presentations

1. Rate, risk, proportion and ratio. Define, and compare and contrast these terms. Provide examples that demonstrate appropriate application.
2. Measures of disease frequency (prevalence, incidence, cumulative incidence, incidence rate, attack rate).
3. Measures of association (strength and effect of factor). Differentiate this from causation.
4. Standardisation. Explain the rationale for use. Compare direct and indirect methods.

Exercises

1. Retained placenta in cattle is a well-defined risk factor for reduced fertility. Twin calvings are a frequent (indirect) cause of retained placenta.

   The magnitude of this effect was quantified using population data from Dutch dairy herds from 1982 to 1988 (Nielen M et al. (1989). Twinning in dairy cattle: a study of risk factors and effects. *Theriogenology* 32: 845 - 862). The following data was adapted from this report. For all 11,943 calvings that occurred over the period, 839 were followed by retained placenta (placenta not expelled by 24 hours after calving). Of these calvings, 369 were twin calvings. Of the twin calvings, 128 were followed by retained placenta. For our purposes, assume that no bias is present in these observations.

   Calculate the following measures and describe the meaning of each:

   Relative risk, odds ratio, population relative risk, population odds ratio, attributable rate, attributable fraction, estimated attributable fraction, population attributable rate, population attributable fraction, estimated population attributable fraction.

2. Identify the measures of disease frequency and/or association used in the following five papers. Give reasons why these measures were used and suggest appropriate alternatives if they exist.

   - Bailey CJ et al. (1997). Risk factors associated with musculoskeletal injuries in Australian Thoroughbred racehorses. Preventive Veterinary Medicine 32: 47-55.
   - Stevenson MA (2000). Disease incidence in dairy herds in the southern highland district of New South Wale, Australia. Preventive Veterinary Medicine 43: 1-11.

- Frei C et al. (1997). The production system and disease incidence in a national random longitudinal study of Swiss dairy herds. Preventive Veterinary Medicine 32:1-21.
- Mounchili et al. (2004). Risk factors for milk off-flavours in dairy herd from Prince Edward Islands, Canada. Preventive Veterinary Medicine 64: 133-145.
- Telfer BL et al. Probable psittacosis outbreak linked to wild birds. Emerging Infectious Diseases 2005:11(3): 391-397.

Example examination questions

1. Using the 2 X 2 table (below) show how to calculate the risk ratio, odds ratio, attributable risk and attributable fraction (2005 oral).

	D+	**D-**
E+	**A**	**b**
E-	**C**	**d**

2. Using examples, write brief notes on case fatality rate and mortality rate (2000 written).
3. Using examples, write brief notes on measuring disease frequency (1999 written).
4. Discuss differences between incidence and prevalence as a measure of disease occurrence. When would you choose one over the other? (1994 written)
5. Write brief notes on the similarities and differences between relative risk and odds ratio (1998 written).
6. Using examples, write brief notes on relative risk and attributable risk (2001 written).
7. Using the data in the table below calculate and explain important epidemiologic measures of association (strength and effect). (2002 written)

	Diseased	**Not diseased**	*Total*
Factor positive	20	5	25
Factor negative	10	10	20
Total	30	15	45

Additional reading/resources

- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 27–36 (disease frequency), pp 61-64 (measures of association)

Meeting 4: Outbreak investigation

Reading

- Sergeant E, Cameron A, Baldock C (2004) Epidemiological Skills for Animal Health Professionals Volume 2: Epidemiological Problem Solving pp 1-36.
- Gay J (2003) Guide for Herd Problem Investigations. Available: http://www.vetmed.wsu.edu/courses-jmgay/OutBGuide.htm

Presentations

1. The key steps in an outbreak investigation

Exercises

1. Work through one (or more) of the example examination questions below.
2. Work through one of the case studies below from Epidemiological Skills for Animal Health Professionals Volume 2: Epidemiological Problem Solving (make sure someone has a copy of the example answers).

- Case study 5: Outbreak investigation – Fish deaths pp 83-101
- Case study 6: Outbreak investigation FMD village outbreak pp 103-108
- Case study 7: Outbreak investigation – Horse deaths pp 109-110

Example examination questions

1. You have been asked to provide epidemiological assistance to a prawn farming enterprise in Costa Rica (Central America). The farm consists of 30 prawn ponds on a 450-acre property. The ponds are stocked with post-larvals in March and June, and prawns are harvested in September and October. The farmer has noticed an increased number of birds over ponds preying on dead prawns.

   On questioning, you are told that survival levels are well below average but vary with the location of the pond. Survival levels are as follows:

   Ponds located on the north side of the enterprise – 39.5% (mean survival), south side 5%, west side 25%, east side 6%

   Your experience in Australia is that survival rates of about 60% are normal. The farm has been operational for 7 years and is not the only farm in the area affected. There was a large variation in mortalities observed between ponds.

   Notable similarities between ponds: water source, feed and feed practices (prawns are fed by broadcast), salinity, age and source of post-larvals.

   Discernible differences between ponds: size, stocking density, average morning temperature and oxygen concentration, date of post-larval stocking.

   Describe your approach to investigating these deaths (2005 written).

2. Recently a number of outbreaks of disease have occurred in wild or free living animals in Australia and NZ. Epidemiologists can play a central role in investigating these types of problems. Discuss the special challenges of investigating outbreaks of free living populations and outline how you would have advised wither fisheries or wildlife authorities investigating one of the following recent outbreaks:

    a) death in pilchards

    b) blindness in kangaroos

    c) wobbly disease in possums (1996 written).

3. A large turkey breeding company has, on two occasions in the last 12 months, experiences extremely high mortality in birds placed with contract growers a day-old poults. Each placement involved several thousand birds. Ten to fifteen percent of the birds died between the ages of three and seven days. The problem then appeared to resolved spontaneously. The outbreaks occurred on two different properties, several months apart. The other eight contract growing properties have not yet experienced the problem. The farm managers keep very good records.

    Describe in detail how you would investigate this problem and how you would prepare for a prospective investigation of similar outbreaks in the future (1997 written).

Additional reading/resources

- Den Boer JW et al (2002) A Large Outbreak of Legionnaires' Disease at a Flower Show, the Netherlands 1999. EID 8(1). Available: http://www.cdc.gov/ncidod/eid/vol8no1/pdf/01-0176%20denboer.pdf
- Ancelle T et al. A multifocal outbreak of trichinellosis linked to horsemeat imported from North America to France in 1993. American Journal of Tropical Medicine and Hygiene, 59(4): 615-619. Available: http://www.ajtmh.org/cgi/reprint/59/4/615
- Reintjes R et al. (2002) Tularemia Outbreak Investigation in Kosovo: Case Control and Environmental Studies. EID 8(1). Available: http://www.cdc.gov/ncidod/eid/vol8no1/01-0131.htm
- Reingold AL (1998) Outbreak Investigations—A Perspective EID 4(1). Available: www.cdc.gov/ncidod/eid/vol4no1/reingold.htm
- CDC: Epidemiology in the Classroom: Steps of an Outbreak Investigation. Available: http://www.cdc.gov/excite/classroom/outbreak/steps.htm
- Neumann GB (1990) Investigation of an Outbreak of Disease. In: Epidemiological skill. Proceedings 143, Postgraduate Committee in Veterinary Science, University of Sydney pp289-318.
- Gardner I (1990) Outbreak Investigation. In: Epidemiology at work. Proceedings 144, Postgraduate Committee in Veterinary Science, University of Sydney pp 7-13.
- Herd outbreak investigation resources for veterinarians: http://www.vetmed.wsu.edu/courses-jmgay/OutBResources.htm
- Thrusfield 3rd Edn pp 398-401

Meeting 5: Sampling

Reading

- Dohoo pp 27 – 52 (sampling).
- Cameron A (1999) Survey Toolbox, available from http://www.ausvet.com.au/resources/LiveToolbox(en).pdf Part 1 Chapter 3 'Sampling' pp 37-47.
- Cannon, R and Roe, R 'Livestock Disease Surveys: A field Manual for Veterinarians', Australian Bureau of Animal Health, Canberra 1982 pp 2-9 (surveys and sampling methods)
- Baldock FC. (1998) What constitutes freedom from disease in livestock? AVJ 76: 544-545.
- Stevenson MA (2005). Introduction to Veterinary Epidemiology: 227.407 Study Guide. Massey University, Palmerston North, New Zealand. pp 53 – 64.

Presentations

1. Probability and non-probability sampling methods
2. Creating sampling frames and sampling techniques
3. Sources of error when sampling and strategies to reduce error
4. I'm designing a study - how many samples should I take?
5. Estimating population parameters on the basis of a sample

Review and comment on the sampling protocol to declare Belize free from classical swine fever at http://www.oirsa.org/Publicaciones/PREFIP/Publicacion-03/ProtocolodeMuestreo-01.htm

Exercises

1. Carefully read the following examples and then choose your preferred sampling unit. Explain your choice.
    1. You wish to estimate the economic losses arising from lameness in sheep in a region. You decide to conduct a survey to estimate the prevalence of lameness in sheep in the region.
    2. You wish to conduct a survey to determine the incidence of foot-and-mouth disease (FMD) outbreaks in pigs from an intensively farmed endemic region of a country during the last year.
    3. You believe that poor stockyards and overcrowding of cattle in abattoirs before slaughter is contributing to carcass bruising. You plan to conduct a study to investigate this proposed risk factor.

2. It is frequent in animal production systems to divide animals into separate groups. Dairy farms (for example) manage lactating and non-lactating stock as separate groups. These divisions can make the collection of a representative sample from a population difficult. Give three examples from livestock enterprises where free mixing of animals is prevented. List all of the sub-groups that may be present in each. How would you obtain a representative sample from each enterprise?
3. Suppose you wish to determine the prevalence of disease within the pig population of a region. Previous surveys have indicated that 70% of the region's pigs are located in very large, intensive specialised pig farms, 20% of pigs are found within smaller farming units (frequently as a secondary industry on large dairy farms), and 10% of pigs are kept singly within small plots around towns (by people whose major occupation is not farming). With proportional stratification, a sample would be selected at random from within each stratum such that the aggregated sample would consist of 70% pigs obtained from the large intensive farms, 20% pigs obtained from the smaller pig farms, and 10% pigs obtained from small plots near towns.

   Explain why it is important for each stratum of pigs to be represented in this sample for the prevalence survey.
4. Assume that the disease that you are investigating is leptospirosis: combine your knowledge of leptospirosis with the description of the farming systems. Is the epidemiology of leptospirosis likely to vary between the different strata?
5. It is decided to do a survey to estimate the prevalence of disease X in a population of cattle. Three experts are asked for their opinions about the expected prevalence and they reply: 75%, 50% and 25%. Assuming that there are 1 million head of cattle in the study area, a desired precision of 5% and a desired confidence level of 95%.

   Calculate the needed sample size according to the three expert opinions.

   When prevalence is unknown and you have absolutely no idea about its expected value, what prevalence estimate should you use for the sample size calculation?
6. Serological surveillance for a disease of poultry is to be conducted in a population of 15,000 villages. Each village contains between 10 and 2100 eligible birds. The mean number of birds per village is 750. The requirement is to be 95% certain of declaring a village positive for disease if the within-village prevalence is greater than or equal to 5% and the between-village prevalence is greater than or equal to 1%. If all birds were tested in sampled villages, how many villages would need to be sampled to achieve the required probability of detection?

Example examination questions

1. Using examples, write brief notes on sampling methods used to select participants in epidemiological studies (2001 written).
2. Briefly describe the essential features and application of stratified random sampling (2002 written).

Additional reading/resources

- Stevenson MA (2005). Sampling. In: 195.721 Analysis and interpretation of animal health data – study guide. Massey University, Palmerston North, New Zealand.
- Bennett S, Woods T, Liyanage W, Smith D (1991) A simplified general method for cluster-sample surveys of health in developing countries. World Health Statistics Quarterly 44: 98 - 106.
- Cameron A (1999) Survey Toolbox, available from http://www.ausvet.com.au/resources/LiveToolbox(en).pdf Part 1 Chapter 3 'Sampling' pp 48-81.
- Noordhuizen, J., Frankena, K., van der Hoofd, C., Graat, E., 1997, Application of Quantitative Methods in Veterinary Epidemiology. Wageningen Pers, Wageningen pp 31 - 62.
- Kelsey, J., Thompson, W., Evans, A., 1986, Methods in Observational Epidemiology. Oxford University Press, New York. pp 254 - 284.

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Meeting 6: Use of diagnostic tests and procedures

Reading

- Thrusfield 2nd Edn or 3rd Edn, Chapter 17 'Diagnostic testing'
- Dohoo et al, pp 85-120 'Screening and diagnostic tests'
- Toma et al (1999) Applied Veterinary Epidemiology and the control of disease in populations Chapter 2 pp 71-86 (herd level sensitivity and specificity)

Presentations

1. Characteristics of tests (sensitivity, specificity, accuracy, precision)
2. Positive and negative predictive values
3. Comparing tests and selection of appropriate diagnostic tests
4. Use of likelihood ratios
5. Herd level sensitivity and specificity

Exercises

1. Diagnosis of fascioliasis in cattle

   Two methods are being compared for the diagnosis of fascioliasis in cattle from the region around Hanoi in Vietnam. Between 3 and 8 samples are collected each week at a local abattoir from cattle of different age groups. These samples include whole liver and gall bladder for total counts of fluke, samples of faeces for fluke egg counts and blood for serum, to be used for an indirect antibody ELISA. So far, 95 livers have been collected, but of these, on 93 have matching serum samples and 65 have matching faecal samples. Of the animals with one or more fluke, 58 had positive and 15 negative results in the ELISA test, whereas in animals with no detectable fluke, 5 sera were positive and 15 negative for the ELISA. Similarly, 38 of the animals infected with fluke had positive egg counts for Fasciola species and 16 had zero counts. Eleven animals were not infected by fluke and all had zero counts for fluke eggs.

   Calculate the sensitivity and specificity for both tests, determine the apparent and true prevalence of fascioliasis in this population and decide on the usefulness of these tests for the diagnosis of fascioliasis in this region.

2. Read journal article Dionysius DA, 1991, Pregnancy diagnosis in diary goats and cows using progesterone assay kits, *Australian Veterinary Journal*, vol 68, no 1, pp 14-16.

   a. For cattle calculate the positive and negative predictive values for diagnosis of pregnancy using the Enzygost Vet test kit (Table 3). Assume a normal conception rate of 55% and no follow up heat detection for determination of pregnancy status.

   b. On the basis of these calculations how would you advise a farmer to interpret a positive and negative test.

3. A test with a sensitivity at the individual level of 99% is to be applied to a population, testing different numbers of animals according to the size of the herd:

   All the animals in herds of less than 20 head

   50% of the animals in herds of 20-50 head

   30% of the animals in herds of more than 50 head

   What is the probability of missing herds with a low level of infection (only 1 infected animal)

   Taken from Toma et al, 1999, *Applied Veterinary Epidemiology and the control of disease in populations* Chapter 2 pp 86

Example examination questions

1. Give a definition of test Se, Sp, PPV, NPV and describe the effect of the prevalence of disease on these values (2005 oral)
2. How can you improve the PPV or NPV? (2005 oral)
3. Describe the important attributes of screening tests (2005 oral)
4. What are the important features of tests used at the beginning and the end of an eradication program? How might you improve the test performance at the end of the eradication program? (2005 oral)
5. How would you compare two diagnostic tests? (2005 oral)
6. What is the difference between precision and accuracy of diagnostic tests? (2005 oral)
7. What is an ROC curve and what is it used for? (2005 oral)
8. Write brief notes to demonstrate your understanding of
   a. Interpretation of herd level sensitivity and specificity
   b. Parallel and series testing (2003 written)
9. Two test for ovine paratuberculosis (*Mycobacterium avium* subsp. *paratuberculosis*) have been developed. One test is an absorbed enzyme linked immunosorbent assay (ELISA) while the other is an agar-gel immuno-diffusino (AGID) test. You have been asked to evaluate these tests. To assist with the study sheep have been made available from farms where ovine paratuberculosis is known to be present and from farms in an area thought to be free. Histologic examination of internal tissue is regarding as the definitive test for ovine paratuberculosis.

   Describe how you would evaluate the performance of these tests (70% of marks). Include in your answer a discussion of how you might compare the performance of the tests (30% of marks).

Additional reading/resources

- Jacobson RH (1998) Validation of serological assays for diagnosis of infectious disease, Rev. sci. tech. Off. Int. Epiz. 17(2): 469-496
- Christensen J et al (2000) Herd level interpretation of test results for epidemiologic studies of animal disease, Prev Vet Med 45(1-2): 83-106
- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 87-95 (use and interpretation of tests at individual and herd level)
- Lehane R, Beating the odds in a big country, the eradication of bovine brucellosis and tuberculosis in Australia pp 46-49, 108-109, 240-241
- Sergent et al (2004) Epidemiological problem solving, Ausvet Series in Epidemiological Skills for Animal Health Professionals. pp 37-57 'Application of diagnostic tests'
- Pitt DJ et al. (2002) An estimate of specificity for a Johne's disease absorbed ELISA in northern Australian cattle. AVJ 80: 57-60.
- Sergeant ESG et al. (2002) Sensitivity and specificity of pooled faecal culture and serology as flock-screening tests for detection of ovine paratuberculosis in Australia. Prev Vet Med 52: 199-211.
- Enoe C et al. (2000) Estimation of sensitivity and specificity of diagnostic tests and disease prevalence when the true disease state is unknown. Prev Vet Med 45: 23-41.
- Greiner M et al. (2000) Principles and practical application of the receiver-operating characteristic analysis for diagnostic tests. Prev Vet Med 45: 61-81.
- Jordan D. (1995) Aggregate testing for the evaluation of Johne's disease herd status. AVJ 73: 16-19.
- Nérette P et al. (2005) Estimation of the repeatability and reproducibility of three diagnostic tests for infectious salmon anaemia virus. Journal of Fish Diseases 28: 101-110.
- Jafarzadeh et al (2004) The sensitivities and specificities of total plasma protein and plasma fibrinogen for the diagnosis of traumatic reticuloperitonitis in cattle. Prev Vet Med 65: 1-7.
- Pooled prevalence calculator http://www.ausvet.com.au/pprev/content.php?page=home

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Meeting 7: Bias, interaction

Reading

- Thrusfield 2nd Edn, pp 230-234 or 3rd Edn, pp 276-280 (bias)
- Thrusfield 2nd Edn pp 75-78, 229-230 or 3rd Edn, pp 92-97, 274-275 (interaction)
- Dohoo et al, pp 207-234 (bias); 235-253 (confounding); pp 253-258 (interaction)

Presentations

1. Bias – definition, types, causes and control options. Alternatively, this could be split into three separate presentations on selection bias, misclassification bias and confounding.
2. Interaction – definition, types and examples.

Exercises

1. You are interested in the effects of age on the occurrence of clinical parvovirus disease in dogs. You go through all practice records for the past 12 months and categorise all dogs on record as either having/not having clinical parvovirus disease over that period. You also record the age of each dog. All of the following factors are associated with age:
    - Breed
    - Sex
    - Location (a high proportion of older dogs are found in the north of your practice area)
    - Vaccination history
    - Number of visits to vet prior to diagnosis

    Which of these factors should be considered as potential confounders of the relationship between age and parvovirus disease and why/why not?
2. Relative to younger cows, older cows are at increased risk of milk fever close to and soon after calving. You wish to estimate the effect of production ability on milk fever incidence. In a cohort study in one large dairy herd, high producing cows (more than 6,000 L of milk produced last lactation) were compared to low producers (less than 4,000 L). Under which of the following circumstances is the observed relationship likely to be confounded by age? Why/why not?

    Study 1: Age was not considered when selecting high and low production groups. Consequently, cows of all ages are included in the study. As it turned out, there were a higher proportion of old cows in the high production group, relative to the low production group.

    Study 2: Only old cows were eligible for inclusion in the study.

    Study 3: Age was not considered when selecting high and low production groups. Consequently, cows of all ages were included in the study. On checking the results, you note that the average age of cows in the high production group was similar to that in the low production group.

3. In an observational study to identify risk factors for neonatal septicaemia in calves, a number of putative risk factors were measured on the day of birth. The outcome (occurrence of neonatal septicaemia) was then determined. Risk factors measured included age and breed of dam, calving ease, colostrum quality (gamma globulin concentration in colostrum), calf suckling vigour soon after birth and calf gamma globulin concentration in serum at 24 to 48 hours after birth (the optimal time to measure these).

   Only 2 factors were associated with neonatal septicaemia occurrence - suckling vigour (vigorous sucklers had a lower incidence) and calf gamma globulin concentration in serum (calves with low concentrations were at increased risk of neonatal septicaemia). Calf gamma globulin concentration was also associated with suckling vigour (vigorous sucklers had higher concentrations).

   You are interested in the relationship between suckling vigour and neonatal septicaemia. Is calf gamma globulin a potential confounder of this relationship?

4. Leptospirosis is contracted by dairy farmers in the dairy, primarily from exposure to urine of infected cows. Herd vaccination is thought to reduce the risk of exposure. This is based on experimental studies where the period of urinary shedding after challenge was much shorter in vaccinated animals relative to non-vaccinates. Supporting this, a cross-sectional study has reported a negative association between leptospirosis serological status of dairy farmers and herd vaccination status. The prevalence of seroconversion was lower in people milking vaccinated herds. Which of the following factors would you seek more information about before you agree with the researchers' conclusion that vaccination reduces the risk of seroconversion in people milking dairy herds? Why?

   - Use of splash guards in the dairy
   - Breed of the herd
   - Wearing of aprons in the dairy
   - Gender of the people milking the herd
   - Attitude and behaviour of people milking the herd to exposure to urine splash
   - Prevalence of urinary shedding amongst cows in the herd

5. For the scenarios listed below, under what conditions would you suspect selection bias? Why?

   Study 1: In the course of practice, dairy practitioners use bacteriology to confirm diagnoses for some cases of suspected salmonellosis in dairy cows. Some dairy practitioners are concerned about the effects of magnesium oxide feeding on susceptibility of cows to salmonellosis and it is possible that suspected cases are sampled for bacteriology more frequently if they are being fed magnesium oxide, relative to suspected cases not being fed magnesium oxide. A case-control study is conducted to investigate risk factors for salmonellosis in dairy cows. Bacteriologically confirmed cases of salmonellosis in dairy cows are compared with controls (the next dairy cow seen by the same vet). Magnesium oxide feeding is again identified as a risk factor for salmonellosis.

   Study 2: Many Western Victorian wool growers consider that ovine dermatophilosis (lumpy wool) is a common problem in weaners sired by rams from a prominent SA merino stud. The disease is readily recognised and accurately diagnosed by most producers. In a case-control study assessing effects of sire source on susceptibility to lumpy wool, case and control flocks (flocks with high and low prevalence of lumpy wool in weaners) are selected from respondents to a series of media items.

Study 3: Following release of the new teat spray “Udderwise”, there were extensive concerns amongst producers and vets that it had contributed to epidemics of clinical mastitis in Australian dairy herds. In an effort to investigate this putative association, you survey all of the practice's dairy clients asking about use of “Udderwise” and clinical mastitis frequency over the past month. Thirty four percent of clients respond, about half of which are using “Udderwise” and half are using other teat sprays. “Udderwise” respondents reported a substantially higher incidence of clinical mastitis than respondents using other teat sprays.

6. Which type of misclassification bias (differential or non-differential) is likely in the following studies?

   Study 1: In 11 dairy herds participating in a herd health program, farmers fail to detect and/or record 50% of cows affected by retained foetal membranes (RFM). However, where records show that RFM occurred, this is invariably true. Not-in-calf cows are identified using whole herd pregnancy testing. A case-control study is then conducted with each not-in-calf cow matched with 5 in-calf cows of similar age and calving date. Records are then examined for a series of potential risk factors for non-pregnancy including occurrence of RFM and other disorders at calving, milk production in early lactation, etc. Effects of RFM on not-in-calf rates are estimated and a strong association observed.

   Study 2: In a study looking at effects of dam Johne's disease (JD) status on progeny JD status amongst dairy cows, pathologists take particular care when histologically assessing tissue from the ileum and caecum from progeny of known-infected dams.

Example examination questions

1. Write brief notes to demonstrate your understanding of measurement error (misclassification) (2005 written).
2. Using examples, write brief notes on handling confounding at the design and analysis stages of a study (2005 written).
3. Using examples, write brief notes on selection bias in epidemiological studies (2002 written).
4. You have been asked to consider lamb mortalities on a property divided by a roadway into two blocks – one block is hilly and the other is flatter and more prone to flood. The owner believes that lambs raised on the flatter block are more likely to die than lambs raised on the hilly block. Because he believes them to be hardier, the owner tends to put more wethers on the flatter block than ewe lambs.

   Part A. The owner has a total of 100 lambs, evenly split between the two blocks. Of these, he has observed 15 dead on the flatter block and 10 dead on the hilly block. Using these data and a contingency table, calculate the relative risk of mortality for lambs born on the flatter (versus hilly) block.

   Part B. Explain how stratified analysis can be used to determine whether a third dichotomous variable (for example, sex of lamb) might confound or otherwise modify the effect of one dichotomous variable on another. Include in your answer, how you would use stratified analysis to delineate between confounding and effect modification. If only confounding is occurring, how might the data be re-analysed?

Part C. The owner now tells you that 30 of his 55 wethers weer sent to the flatter block. Of these, 6 subsequently died, whilst only 4 wethers from the hilly block died. He also tells you that 9 of the ewe lambs on the flatter block died. Use stratified analysis and the data above to determine whether the sex of the lambs is likely to be confounding or otherwise modifying the effect of block on lamb mortality (2003 written)

Additional reading/resources

- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 67-74 (confounding and interaction)
- Multicausality: Effect modification. Available: www.epidemiolog.net/evolving/Multicausality_EffectModification.pdf

Meeting 8: Observation studies 1

Reading

- Cameron A (1999) Survey Toolbox, available from http://www.ausvet.com.au/resources/LiveToolbox(en).pdf Part 1 Chapter 2 'General Principles of Animal Disease Surveillance' pp 11-36, Part II 'Survey design and analysis' Chapters 7,8,9 pp 143-189.
- Thrusfield 2nd Edn pp 221-224 or 3rd Edn pp 266-288 (Observational Studies).
- Thrusfield 2nd Edn pp 178-191 or 3rd Edn pp 228-246 (Surveys)
- Dohoo Chapter 7 'Introduction to observational studies' pp 139-146
- Baldock FC. (1998) What constitutes freedom from disease in livestock? AVJ 76: 544-545.

Presentations

1. Types of observational studies (including strengths and weaknesses)
2. Discuss the circumstances when a cross sectional study is most appropriate, the key design features and the statistics that can be calculated.
3. 'Is Vitamin D intake associated with the risk of Multiple Sclerosis?'. One member of the group should **briefly** research MS – occurrence, hypothesised risk factors etc and bring their findings to the session (5 minutes worth). At the meeting members of the group allocate themselves to different study types (cross-sectional, case-control, cohort and intervention/clinical trial) and discuss how they would conduct a trial examining this question using their nominated design. The design should include exposure and outcome and concentrate on the strengths and weaknesses of their study type.

Exercises

1. Work two (or more) of the example examination questions below.
2. Select two (or more) of the following papers
    - Schouten J et al (2004) Prevalence estimation and risk factors for Escherichia coli O157 on Dutch dairy farms. Prev Vet Med 64:49 - 61.
    - Jackson R et al (2004) Survey of the seroprevalence of brucellosis in ruminants in Kosovo. Veterinary Record 154(24):747 - 751.
    - Cole FL et al. (2004) Prevalence and demographic characteristics of exertional rhabdomyolysis in horses in Australia. Veterinary Record 155: 625-630.
    - Garner MG et al. (1997) A national serological survey to verify Australia's freedom from porcine reproductive and respiratory syndrome. AVJ 75: 596-600.
    - Small L and Pinch DS. (2003) Survey for hydatidosis in cattle bred in the northern region of the Northern Territory of Australia. AVJ 81: 355-358.

    Discuss the design and conduct of these studies

Example examination questions

1. Describe the circumstances where collection of data on disease occurrence from an abattoir would be appropriate. What are the limitations of this method? (2005 oral)
2. Write brief notes on selection of subjects for a cross sectional study (2005 written)
3. *Babesia gibsoni* has recently been found in Pit Bull terriers in Victoria. However little is known about its distribution or prevalence in Australia. You have been asked to design a study to identify the prevalence of *Babesia gibsoni* in the Australian dog population.

   What type of study would you use and what are the strengths and weaknesses of your chosen study design? Describe the study design, including study objectives, hypothesis, unit of interest, reference and study populations.

   What sampling methods would you use and how would you select your sample size?

   Discuss possible means of data collection and the advantages and disadvantages of alternative sources of data.

   Describe any potential biases and how you may control these.

   Discuss how you would analyse and interpret the results.(2003 written)
4. Canine coronavirus is becoming an agent of concern to small animal practitioners. In particular there is some controversy regarding the prevalence of seropositive dogs and the role that the virus may play in canine gastroenteritis. As a consultant epidemiologist you have been asked to design and carry out a cross-sectional study to investigate these problems. Describe how you would proceed with planning the study, including discussion of important factors affecting study design. (2002 written)
5. Salmonella enteritidis (SE) is a common cause of food poisoning in many countries, with the main source of infection being raw or partly cooked eggs and egg products. For example human illness from SE positive eggs in the United States is now approximately 637 000 cases per year. SE in chickens causes a silent systemic infection that can be detected by both bacteriological and serological techniques. Prevalence of infection in naturally infected commercial layers has been found to be very low.

   The Australian and New Zealand egg industries are thought to be free of SE infection and relatively few human cases occur in either country compared to overseas. No human cases of SE due to consumption of Australian or New Zealand eggs have been reported. You have been engaged by the egg industry in your country (Australia or New Zealand) to plan an epidemiological study to demonstrate freedom from SE. Describe how you would proceed with this project and discuss the key issues affecting study design.
6. A pharmaceutical company has commissioned you as an epidemiologist to identify the major health issues associated with pet dogs in NZ/Australia to help them review the direction of the R & D program. You have one year in which to complete the project and a generous, although not unlimited budget available to you.

   Describe how you would go about fulfilling this task, giving details of:

   a. The different sources of information on dog health that you might use (25%)
   b. The way in which you would collect data from these sources (50%)

c. The strengths and weaknesses of each with respect to data quality and ease with which the information can be collected (25%)

7. Infectious bovine rhinotracheitis (IBR) is a viral infection of cattle that is endemic in Australian herds. The virus occurs worldwide, but strains overseas appear to be more pathogenic and have been subject to eradication programs in some countries. Although we now that IBR occurs in Australia, and that Australian strains are less pathogenic than overseas strains, we know very little about the prevalence or distribution. You have been asked to design a survey to estimate he prevalence of IBR infected herds in the country.

   Describe how you would proceed with designing such a survey and discuss factors that influence your decisions at each major step of the design.

Additional reading/resources

- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 39-47 (Investigation methods), pp 49-55 (surveys), pp 57-64 (observational studies and measures of association) pp 111-119 (monitoring), pp 151-158 (survey design), pp 337-351 (using existing data sources), pp 353-361(monitoring and surveillance).
- East IJ et al (2004) Survey for the presence of White Spot Syndrome Virus in Australian crustaceans. AVJ 82:4, 236-239.
- Black PF et al (2001) Serological examination for evidence of infection with Hendra and Nipah viruses in Queensland piggeries. AVJ 79:6, 424-426.

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Meeting 9: Observational studies 2

Reading

- Dohoo Chapter 8 'Cohort Studies', pp 151-162, Chapter 9 'Case-Control Studies', pp 163-175 and Chapter 10 'Hybrid Study Designs' pp 177-184.
- Thrusfield, 2nd Edn, pp 220-223 or 3rd Edn, pp 266-269 (Observational studies)
- Stevenson MA (2005). Introduction to Veterinary Epidemiology: 227.407 Study Guide. Massey University, Palmerston North, New Zealand. pp 24 – 32.
- Schlesselman, J., 1982, Case-Control Studies Design, Conduct, Analysis. Oxford University Press, New York.

Presentations

1. Advantages and disadvantages of case-control studies.
2. Advantages and disadvantages of retrospective and prospective cohort studies.
3. Hybrid study designs (for example, nested case-control studies).

Exercises

Critically appraise a selection of the following papers. What are the positive and negative features of the study design used in each study?

- Chesterton, R., Pfeiffer, D., Morris, R., Tanner, C. (1989) Environmental and behavioural factors affecting the prevalence of foot lameness in New Zealand dairy herds - a case-control study. NZ Vet J 37: 135 - 142.
- Johansen C, Boise J, McLaughlin J, Olsen J (2001). Cellular telephones and cancer --- a nationwide cohort study in Denmark. Journal of the National Cancer Institute, 93: 203 - 237.
- Muscat JE, Malkin MG, Thompson S, Shore RE, Stellman SD, McRee D et al. (2000). Handheld cellular telephone use and risk of brain cancer. Journal of the American Medical Association, 284: 3001 - 3007.
- Parsonnet J, Friedman GD, Vandersteen DP, Chang Y, Vogelman JH, Orentreich N, Sibley RK (1991). Helicobacter pylori infection and the risk of gastric-carcinoma. New England Journal of Medicine, 325(16): 1127 - 1131.
- Neilen M (1989) Twinning in dairy cattle: a study of risk factors and effects. Theriogenology 32(5):845-861.
- Steenholdt C and Hernandez J (2004) Risk factors for umbilical hernia in Holstein heifers during the first two months after birth. JAVMA 224(9):1487-1490.
- Wilesmith JW et al (1997) A cohort study to examine maternally associated risk factors for bovine spongiform encephalopathy. Veterinary Record, 141: 239-243.
- Healy AM et al (2004) A paired case-control study of risk factors for scrapie in Irish sheep flocks. Prev Vet Med 64: 73-83.

Example examination questions

1. Write brief notes to demonstrate your understanding of case-control studies (2001 written).
2. A veterinary practitioner asks you for epidemiological advice about an apparent problem amongst Huntaway dogs (a breed of sheep dog). On the basis of dogs presented to his clinic the practitioner suspects that Huntaways have a higher incidence of hip dysplasia (HD). This concern is of some importance as many sheep dogs in New Zealand are Huntaways. How would you advise this veterinarian to go about determining in Huntaways are, in fact, at greater risk than other breeds of dog of being affected by HD? (2000 written)
3. Crohn's disease is a disease of humans with many similarities to Johne's disease in ruminants. It is a chronic inflammatory condition of the intestines that is histologically similar to Johne's disease. Mycobacterium paratuberculosis has also been isolated from some cases of Crohn's disease, but this is not a consistent finding. There is increasing concern that exposure to M. paratuberculosis is a cause of Crohn's disease, but existing evidence for causality is limited. There is particular concern about risks to people exposed to dairy cattle infected with M. paratuberculosis.

   You are part of a research team of epidemiologists which has been asked to investigate this issue on an epidemiological, rather than bacteriological basis, focussing on risks to people exposed to infected dairy cattle. You have reasonable resources at your disposal. Describe how you would proceed (1999 written)

Additional reading/resources

Kelsey, J., Thompson, W., Evans, A., (1986). Methods in Observational Epidemiology. Oxford University Press, New York. pp 77 – 147 and pp 148 – 186.

Meeting 10: Intervention studies

Reading

- Dohoo Chapter 11 (controlled trials) Chapter 2 (sampling, sample size)
- Thrusfield 2nd Edn or 3rd Edn, Chapter 16 (clinical trials)
- Committee for Proprietary Medicinal Products (CPMP). 2000. Points to consider on switching between superiority and non-inferiority. Available: http://www.emea.eu.int/pdfs/human/ewp/048299en.pdf
- CONSORT statement: Revised recommendations for improving the quality of reports of parallel group randomised trials 2001. Available: http://www.consort-statement.org/Statement/revisedstatement.htm

Presentations

1. Key considerations in designing an intervention study
2. Outcome measures: compare non-inferiority, superiority and equivalence trials; discuss power, p-values and confidence intervals when interpreting results.
3. Vaccine trials: vaccine efficacy, herd immunity, unit of interest, atomistic and ecological fallacies
4. Control of biases (randomisation, blinding)

Exercises

1. Read and assess the following papers (or any other recent papers you may find). You can use the CONSORT checklist to help with this:

- Dias PT, Alders RG, Fringe R and Mata BV. Laboratory and Field Trials with Thermostable Live Newcastle Disease Vaccines in Mozambique. Available: http://www.aciar.gov.au/web.nsf/att/JFRN-6BN93R/$file/pr103chapter19.pdf
- Cusack PMV (2004) Effect of mass medication with antibiotics at feedlot entry on the health and growth rate of cattle destined for the Australian domestic market. AVJ, 82:154-156.
- Williamson JH, Woolford MW and Day AM (1995) The prophylactic effect of a dry-cow antibiotic against Streptococcus uberis. NZVJ, 43: 228-234.
- Karpathy RC, Firth GA and Tannock GA (2003) Field evaluations of safety and efficacy of an Australian Marek's disease vaccine. AVJ 81: 222-225.

1. Work through as a group one of the following exam questions.

Example examination questions

1. A new genetically engineered vaccine has recently been developed for infectious bronchitis virus in poultry. This vaccine can be applied to individuals as day-old chicks or as a mass vaccination. It has undergone extensive laboratory evaluation and the developers are now ready to commence field trials under commercial conditions. You have been asked to design a field study to evaluate the efficacy of the vaccine in preventing mortalities and production losses in commercial broiler enterprises. Describe how you would proceed (2001 written).
2. A live avirulent Toxoplasma vaccine is very effective in preventing Toxoplasma abortions in sheep. Toxoplasma gondii is closely related to Neospora caninum, so it is possible that the live Toxoplasma vaccine would be efficacious against Neospora abortions in cattle. This hypothesis requires investigation and a field trial is desired. Describe how you could investigate the efficacy of the sheep Toxoplasma vaccine in preventing bovine Neospora abortions using a field trial approach (2000 written).
3. You are a consultant to a veterinary pharmaceutical company that is about to try and register a new product for the treatment of osteoarthritis in dogs. The new product is a different formulation of the same active ingredient as an existing product already on the market. Accordingly, the company wants registration on the basis that the two products are equally effective. A clinical trial is required and a number of veterinary practises in Australia are available to assist. Describe in detail the study or studies that you would recommend in this situation (1999 written).
4. Write brief notes, using examples, to demonstrate your understanding of matching in clinical trials (1995 written).

Additional reading/resources

- Jones B, Jarvis P, Lewis JA and Ebbutt AF (1996) Trials to assess equivalence: the importance of rigorous methods. BMJ, 313: 36-39 (Available by searching www.bmj.com/)
- Beller EM, Gebski V and Keech AC (2002) Randomisation in clinical trials. MJA, 177: 565-567. Available: http://www.mja.com.au/public/issues/177_10_181102/bel10697_fm.html
- Altman DG and Bland JM (1995) Absence of evidence is not evidence of absence. BMJ, 311: 485. Available: http://bmj.bmjjournals.com/cgi/content/full/311/7003/485
- Dohoo IR and Thomas FC (1989) Clinical trials in veterinary medicine Can Vet J, 30: 291-303.
- Baldock C (1991) New Approaches to disease investigation. An update on clinical trials. Dairy Medicine and Production, Proceedings 161, Postgraduate Committee in Veterinary Science, University of Sydney, p.423-437.
- Hedges J et al (2001) A longitudinal field trial of the effect of biotin on lameness in dairy cows. J Dairy Science 84:1969-1975.

Meeting 11: Questionnaires, data management, data analysis 1

Reading

- Thrusfield 2nd Edn, pp 191-198 (questionnaires); pp 151-166 (data management) or 3rd Edn, pp 188-204 (questionnaires and data management)
- Thrusfield 2nd Edn, pp 129-131 or 3rd Edn, pp 152-156 (data types);
- Thrusfield 2nd Edn, pp 167-171 or 3rd Edn, 214-216, 220-224 (descriptive statistics, including confidence intervals)
- Thrusfield 2nd Edn, pp 171-174 or 3rd Edn, 217-220 (statistical distributions);
- Thrusfield 2nd Edn, pp 174-177 or 3rd Edn, pp 224-227 (presenting numerical data)
- Dohoo et al, pp 53-63 (questionnaires), 581-586 (data management); pp 586-589 (data analysis)
- Petrie and Watson pp 153-156 (transformation)

Presentations

1. Design and conduct of questionnaires. What different types are there, and what are the strengths and weaknesses of each?
2. Methods of data management. Common data problems, what effect they can have on the interpretation of the data, and how to avoid them
3. Summarise the different types of data. For each type provide a definition and example.
4. Displaying data: measures of centrality and dispersions, confidence intervals.
5. Data distributions and transformations – When is transformation indicated, and how do you do it?

Exercises

1. Compare and contrast methodologies used for the following questionnaires, concentrating on the principles of design and conduct:

- Baldock FC et al. (2003). Estimated and predicted changes in the cat population of Australian households from 1979 to 2005. AVJ 81: 289-292.
- Buckley P et al. (2004). Owners' perceptions of the health and performance of Pony Club horses in Australia. Prev Vet Med 63: 121-133.
- Heller J et al. (2005). Snake envenomation in dogs in New South Wales. AVJ 83: 286-292.
- Wraight MD et al (2000) Compliance of Victorian diary farmers with current calf rearing recommendations for control of Johne's disease. Veterinary Microbiology 77:429-442.

Example examination questions

1. Using examples, write brief notes on data types (2000 written).

2. Write brief notes to demonstrate your understanding of when it is appropriate to use postal questionnaires to conduct epidemiological surveys and how to address the potential weaknesses of this method (1998 written).

3. Write brief notes using examples about paired versus independent data (1997 written).

Additional reading/resources

- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 151-158 (questionnaires), 215-222 (data types and descriptive statistics).
- Cameron A. et al. (2004) Data management for animal health. AusVet Animal Health Services, Brisbane, Australia.
- Salman MD et al. (1990). Data description. Journal of American Veterinary Medical Association 197: 36-38.
- Shott S (1990). Confidence intervals. Journal of American Veterinary Medical Association 197: 576-578.

Meeting 12: Data Analysis 2

Reading

Comprehensive and easy to understand references on this area are difficult to find, hence the large list of recommended reading below.

Hypothesis testing, p-values and confidence intervals

- Curtis CR, Salman MD and Shott S (1990) Statistics simplified – P values, Journal of the American Veterinary Medical Association, 197(3): 318-320
- Shott S (1990) Statistics simplified – Confidence intervals, Journal of the American Veterinary Medical Association, 197(5): 576-578

  OR
- Thrusfield 2nd Edn, pp 199-219 or 3rd Edn, pp 247-265 (estimation and hypothesis testing)

  OR
- Petrie and Watson pp 69-75 (hypothesis testing)

  OR
- Dohoo, pp 131-136 (Hypothesis testing and confidence intervals)

Statistical tests

- Curtis CR, Salman MD and Shott S (1991) Statistics simplified – Comparing means, Journal of the American Veterinary Medical Association, 198(1): 62-65.
- Shott S (1990) Statistics simplified – Comparing proportions, Journal of the American Veterinary Medical Association, 197(11): 1460-1462.
- Shott S (1990) Statistics simplified – Association, Journal of the American Veterinary Medical Association, 198(3): 404-407.
- Shott S (1990) Statistics simplified – Nonparametric statistics, Journal of the American Veterinary Medical Association, 198(7): 1126-1128.

  OR
- Petrie and Watson pp 78-88 (t-test and hypothesis testing), pp 90-92 (F-test for variance), pp 101-112 (Chi-squared test and hypothesis testing) pp 138-150 (non-parametric tests)

Standardisation

- Thrusfield 2nd Edn, pp 49-52 or 3rd Edn, pp 63-65 (standardisation)

Stratified analysis, clustering and sources of error

- Thrusfield 2nd Edn pp 232-234 or 3rd Edn, pp 278-280 (Mantel-Haenzel procedure)
- Dohoo, pp 29-30 and 40 (types of error), pp 459-471 (clustering and stratified analysis).
- Curtis CR, Salman MD (1990) Statistics simplified – Power and sample size, Journal of the American Veterinary Medical Association, 197(7): 838-840.
- Petrie and Watson pp 175-178

Presentations

1. Hypothesis testing, power, type 1 and 2 errors
2. Basic statistical tests
   - Unit of analysis
   - Independence
   - Parametric and non parametric tests (including underlying assumptions, applications and limitations)
   - Tests for different data types
3. Stratified analysis and the Mantel-Haenzel procedure
4. Identifying 'tricky data' – paired and matched data, repeated measures on the same animals, clustered data and autocorrelation

Exercises

1. Read the following papers and discuss how clustering was accounted for during the design and analysis stages of the studies.
   - Gitau GK, Perry BD, Katende JM, McDermott JJ, Morzaria SP and Young AS (1997) The prevalence of serum antibodies to tick-borne infections in cattle in small holder dairy farms in Murang'a District, Kenya; a cross-sectional study. Prev Vet Med 30: 95-107.
   - Haine D, Boelaert F, Pfeiffer D, Saegerman C, Lonneux J-F, Losson B, Mintiens K (2004) Herd level seroprevalence and risk mapping of bovine hypodermosis in Belgian cattle herds. Prev Vet Med 65: 93-104.
2. Work through the following CDC exercise on oral contraceptive use and ovarian cancer: http://www.cdc.gov/eis/casestudies/Xocovca.student.811-703.pdf

Example examination questions

1. Define the null and alternative hypothesis. (2005 oral)
2. What is a p value and how is it determined? (2005 oral)
3. What are the application, advantageous and limitations of parametric and non-parametric test? Give 2 examples of each type of test. (2005 oral)
4. Briefly describe the essential features, application and limitations of
   a. Stratified analysis (2005 written)
5. Using examples write brief notes on
   a. p values and significance testing (2003 written)
   b. confidence intervals (2002 written)
   c. power in epidemiological studies (2001 written)

Additional reading/resources

- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 222 - 236 (analysing epidemiologic data)
- McDermott JJ, Schukken YH and Shoukri MM. Study design and analytic methods for data collected from clusters of animals. Prev Vet Med 18: 175-191.
- McDermott JJ, Schukken YH. A review of methods used to adjust for cluster effects in explanatory epidemiological studies of animal populations. Prev Vet Med 18:155-173.

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Meeting 13: Data analysis 3

Reading

Comprehensive and easy to understand references on this area are difficult to find, hence the large list of recommended reading below.

Linear regression

- Shott, S (1991) Statistics simplified: Regression. JAVMA 198: 798 - 801.

  OR

- Dohoo Chapter 14, pp 273-313 (for sections 14.5, 14.6,. 14.9 and 14.10, identify major points only)

Logistic regression

- Shott, S (1991) Statistics simplified: Logistic regression and discriminant analysis. JAVMA 198: 1902 - 1905.
- Bennett, D (2001) Logistic regression analysis: an epidemiological perspective. Australasian Epidemiologist 8: 38 - 44.

  OR

- Dohoo Chapter 16, pp 335-370 (for sections 16.6, 16.7, 16.10-16.14, identify major points only)

Survival analysis

- Shott, S (1991) Survival analysis. JAVMA 198: 1513 - 1515.
- Dohoo Chapter 19, sections 19.1-19.7.5, 19.8.2 pp 409-424, p 428

  OR

- Stevenson MA (2005). Introduction to Survival Analysis: 195.721 Study Guide. Massey University, Palmerston North, New Zealand. pp 1 – 11.

Meta-analysis

- Egger M, Davey Smith G (1997) Meta-analysis: Potentials and promise. British Medical Journal 315: 1371 - 1374.

  OR

- Thrusfield 3rd edn, pp 300-304 (meta analysis)
- Dohoo Chapter 24; pp 543-558

  AND

- Cochrane Collaboration Open Learning Material for Reviewers. URL: http://www.cochrane-net.org/openlearning/. Chapter 3.

Presentations

Choose one of the statistical techniques listed above (linear regression, logistic regression, survival analysis, meta-analysis). Imagine you are to give a 20 minute presentation about this technique to a group of colleagues who know very little about epidemiology (or statistics). Your talk should include:

- A description of what the technique is used for.
- A [brief] description of the principles and assumptions that underpin the technique.
- Examples of where the technique has been used to provide insight into an animal health problem.
- What to look out for when evaluating studies that have used the technique.

Exercises

Critically appraise three or more of the following four studies, describe the following:

a) objectives of the data analyses
b) the unit(s) of analysis
c) types of data (outcome and exposure variables)
d) the type of analysis used (linear regression, logistic regression, survival analysis, meta-analysis) and why that approach was appropriate
e) any potential sources of clustering

- Arunvipas P, Dohoo I, VanLeeuwen J, Keefe G (2003) The effect of non-nutritional factors on milk urea nitrogen levels in dairy cows in Prince Edward Island, Canada. Preventive Veterinary Medicine 59, 83 - 93.
- Borges V, Bernardi M, Bortolozzo F, Wentz I, (2005) Risk factors for stillbirth and foetal mummification in four Brazilian swine herds. Preventive Veterinary Medicine 70, 165 – 176 [logistic regression].
- Matsuda R, Morizane T, (2005) Helicobacter pylori infection in dental professionals:A 6-year prospective study. Helicobacter 10, 307 – 311 [logistic regression].
- Proudman C, Smith J, Edwards G, French N (2002) Long-term survival of equine surgical colic cases. Part 1: Patterns of mortality and morbidity. Equine Veterinary Journal 34, 432 – 437 [survival analysis].
- Rabiee AR, Lean IJ, Stevenson MA (2004) A Bayesian meta-analysis of the effects of administering an intra-vaginal (CIDR) device in combination with other hormones on the reproductive performance of cycling, anoestrous and inseminated cows. New Zealand Veterinary Journal 52 (6): 384-393
- Wilesmith JW, Ryan J BM, Stevenson MA, Morris RS, Pfeiffer DU, Lin D, Jackson R, Sanson RL (2000) Temporal aspects of the epidemic of bovine spongiform encephalopathy in Great Britain: holding-associated risk factors for the disease. Veterinary Record 147 (12): 319-325

- Singer ER, Saxby F, French NP (2003) A retrospective case-control study of horse falls in the sport of horse trials and three-day eventing. Equine Veterinary Journal 35 (2): 139-145

- Charlier J, Claerebout E, Muelenaere E. de, Vercruysse J (2005) Associations between dairy herd management factors and bulk tank milk antibody levels against Ostertagia ostertagi. Veterinary Parasitology 133 (1): 91-100

- Sanchez J, Dohoo I, Carrier J, DesCoteaux L (2004) A meta-analysis of the milk-production response after anthelmintic treatment in naturally infected adult dairy cows. Preventive Veterinary Medicine 63, 237 – 256 [meta-analysis].

Example examination questions

1. Describe the application, advantages and limitations of linear regression in veterinary epidemiology.
2. Describe the application, advantages and limitations of logistic regression in veterinary epidemiology.
3. Briefly describe the essential features and application of survival analysis (2003 written).
4. Describe the application, advantages and limitations of meta-analysis (2005 oral).

Additional reading/resources

- Noordhuizen J, Frankena K, van der Hoofd C, Graat E (1997) Application of Quantitative Methods in Veterinary Epidemiology. Wageningen Pers, Wageningen pp 135 – 178 [logistic regression].
- Ottenbacher K, Ottenbacher H, Tooth L, Ostir G (2004) A review of two journals found that articles using multivariable logistic regression frequently did not report commonly recommended assumptions. Journal of Clinical Epidemiology 57, 1147 – 1152 [logistic regression].
- Noordhuizen J, Frankena K, van der Hoofd C, Graat E (1997), Application of Quantitative Methods in Veterinary Epidemiology. Wageningen Pers, Wageningen pp 179 – 214 [survival analysis].

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Meeting 14: Herd health, disease control and eradication programs

Reading

- Thrusfield 2nd Edn, pp 322-336 or 3rd Edn, pp 368-383 (herd health)
- Thrusfield 2nd Edn, pp 337-348 or 3rd Edn, pp 384-404 (disease control and eradication programs)
- Thrusfield 3rd Edn, pp 168-187 (surveillance and monitoring programs)

Presentations

1. Herd health programs: principles, design, strategies, limitations and methods of monitoring success/progress.
2. Regional/national disease control and eradication programs: principles, design, strategies, limitations and methods of monitoring success/progress.
3. Demonstrating freedom from disease (both a descriptive approach, and a revisit of sampling)

Exercises

1. The Global Rinderpest Eradication Program (GREP) is a time-bound program to eliminate rinderpest from the world by the year 2010. Discuss the epidemiological issues which would have to be evaluated before global eradication of a disease such as rinderpest could be considered an achievable objective over a period of 20 to 30 years. Focus your answer on the epidemiological principles, not the specific details of the example disease.
2. The initial decision on whether or not to undertake a national control program for a specific disease of major importance may be influenced by many factors. Using as examples one of more diseases with which you are familiar, discuss the factors which you believe should be taken into account, and describe the role which you, as an epidemiologist, might play in assisting the decision-making process.
3. As a veterinary practitioner, you are asked by a client to develop a herd health program for a dairy cattle herd. Provide an overview of how you would do this, including design features and implementation. Focus on the epidemiological principles.
4. Discuss national disease monitoring and surveillance programs (eg. TGSP, NAQS)

Example examination questions

1. Virulent footrot (VFR) of sheep is considered by many to be a significant disease that is of economic importance to flock owners and the sheep industry as a whole. However, there are others who consider it to be of no importance. You have been asked to provide advice to the Animal Health authorities on the merits of proceeding with a control program. Describe the factors that you would consider and outline any activities you would implement to assist in reaching a recommendation. (2003 written)

2. A program to eradicate brucellosis from cattle in New Zealand has been in place for a number of years and the prevalence of infected herds has been substantially reduced and is now quite low. The program objective remains unchanged – to eradicate brucellosis from cattle in New Zealand.

   Programs to eradicate contagious diseases from animal populations in regions have specific features which can change during the course of such programs. Contrast the major issues associate with the design and implementation of such an eradication program between two stages: stage 1 – early in such a program, and stage 2 – once the disease prevalence has been reduced to a low level.

   Explain why such changes are required. The emphasis in this question is not on the specific epidemiology of brucellosis but is on the differing issues that need to be addressed as a program to eradicate a contagious disease proceeds (2000 written).

Additional reading/resources

- Epidemiological Skills in Animal Health, PGFVS Proceedings 143; pp 141-148 (disease control programs), pp 353-361 (monitoring performance of regional programs)
- Davidson RM (2002) Control and eradication of animal diseases in New Zealand. NZ Vet J 50(3) supplement: 6-12.
- Pharo H (2002). New Zealand declares 'provisional freedom' from hydatids. Surveillance 29(3):3-7. Available from http://www.sciquest.co.nz/crusher_download.asp?article=9003829
- Taylor WP et al. (1995). The principles and practice of rinderpest eradication. Veterinary Microbiology 44: 359-367.
- Tweedle NE and Livingstone P (1994). Bovine tuberculosis control and eradication programs in Australia and New Zealand. Veterinary Microbiology 40: 23-29.
- Radostits OM et al. (1994). Herd Health. 2nd edition, WB Saunders, Philadelphia, USA pp 10-24.

Meeting 15: Modelling and Risk Analysis

Reading

Modelling

- Thrusfield 2nd Edn, pp 296-311 or 3rd Edn pp 340-356
- Hurd H, Kaneene J (1993) The application of simulation models and systems analysis in epidemiology: a review. Prev Vet Med 15: 81 - 99.

Risk Analysis

- McDiarmid S (1991) Risk analysis and the importation of animals. Surveillance 18(5): 8-11.
- Biosecurity Australia (2003) Import risk analysis handbook, Agriculture, Fisheries and Forestry– Australia, Canberra.
- Pharo HJ (2002) Foot-and-mouth disease: an assessment of the risks facing New Zealand. New Zealand Veterinary Journal 50(2): 46-55.
- MacDiarmid S and Pharo H (2003) Risk Analysis: assessment, management and communication. Rev. sci. tech. Off. Int. Epiz 22(2) 397-408

Presentations

1. Examples of where simulation modelling has been useful in devising methods to control disease or enhance production in animals (e.g. foot-and-mouth disease, classical swine fever, UDDER, AusPIG).
2. Mathematical vs simulation models – advantages and disadvantages.
3. Deterministic vs stochastic models – advantages and disadvantages.
4. Terms used in risk analysis: hazards, risk assessment, risk management, risk communication. Applications, principles and components of risk analysis.
5. An overview of The Sanitary and Phytosanitary Agreement and The Technical Barriers to Trade Agreement from the Uruguay Round of World Trade Organisation negotiations.
6. Advantages and disadvantages of qualitative, semi quantitative and quantitative risk analysis methods.

Exercises

1. List the potential disease hazards that should be considered when importing adult cattle from Australia into New Zealand. The following resources might be useful:
   - The HandiStatus page and the International Animal Health Code on the OIE web site: http://www.oie.int.
   - Various risk analyses on the MAF New Zealand web site: http://maf.govt.nz.
   - Market access and biosecurity documents on the Australian Government Department of Agriculture Fisheries and Forestry web site: http://www.affa.gov.au.
   - Disease status of Pacific Island countries - see the Secretariat of the Pacific Community web site: http://www.spc.org.nc/.

2. You have been asked to qualitatively assess the risk that Parma ham (from Parma, Italy) will be infected with classical swine fever at the point of import into your country. Consider the following information:

   Pigs for Parma ham come from the Parma region of Italy. Classical swine fever is endemic in Italy. Experimental evidence suggests that classical swine fever virus is inactivated within Parma hams over a period of around 6 months. The minimum curing time for Parma ham is 12 months. Parma ham, as it will be imported into you country will be designated 'Prosciutto di Parma' and qualifies for official certification. Ham contains mainly muscle meat, and experimental studies show that classical swine fever virus is present in high concentrations in muscle.

   Draw a diagram to outline the release risk pathway. For each step of the pathway, make an assessment of the probability that classical swine fever virus might be present. Make an overall assessment of the probability of the risk that Parma ham will be infected by classical swine fever virus at the point of import into your country. Set your results out in a transparent qualitative risk assessment format.

3. Using the concepts in the paper by Carpenter develop (on paper/whiteboard) a model for the spread of disease of an infectious disease relevant to your work. What inputs need to be included, what outputs would you like to generate and how could the model assist you to make decisions.

Example exam questions

1. Briefly describe the essential features, applications and limitations of epidemiological simulation models (2005 written).
2. Using examples, write brief notes on the advantages and disadvantages of quantitative risk analysis models (2003 written).
3. As a government epidemiologist, you have been asked to undertake an import risk analysis for the importation of horse semen from South America. Describe how you would proceed (2002 written).
4. The risk of animal or zoonotic disease is an important consideration for countries importing agricultural products. Under the WTO-SPS Agreement, it is important that any restrictions placed on trade for animals, plant, or human health are based on international standards or on the outcomes of a scientifically sound import risk analysis. It is also important that countries considering health risks do so in a way that is consistent across all imports.

   a. The OIE Terrestrial Animal Health Code (the Terrestrial Code) provides proctocols relating to the management of the risks associated with a range of important diseases. The Terrestrial code also provides an explanation of the steps required for a scientifically sound import risk analysis, for those cases where disease-specific propotcols do not exist or are not considered sufficient to meet an importing countries accepted level of risk. Explain the key steps in carrying out an import risk analysis, as described in the Terrestrial Code.

   b. One of the questions facing import risk analysts is the decision to carry out a qualitative or quantitative assessment of likelihood. What do you see to be the advantages and constraints of each approach, and in what situations might each be most appropriate.

c. A critical step in any import risk analysis is the evaluation of a risk estimate. What do you feel to be the important components of an import risk estimate? How might these components be combined? How might the import risk estimate be evaluated? IN answering these questions, consider methods or approaches for qualitative and quantitative components, as you see relevant.

d. A final step in many import risk analyses is the specification of risk management options. What do you understand by the principle of 'least trade restrictive measures', and how would you ensure these are specified? What do you understand by the principle of equivalence?

Additional reading/resources

- De Jong M (1995) Mathematical modelling in veterinary epidemiology: why model building is important. Prev Vet Med 25: 183-193.
- Nairn ME, Allen PG, Inglis AR, Tanner C (1996) Australian Quarantine, Department of Primary Industries and Energy, Canberra, ISBN 0 642 25971 2, pp 83 - 113.
- Noordhuizen J, Frankena K, van der Hoofd C, Graat E (1997) Application of Quantitative Methods in Veterinary Epidemiology. Wageningen Pers, Wageningen pp 247 – 270.
- Taylor N (2003) Review of the use of models in informing disease control policy development and adjustment (London, Defra). URL: http://www.defra.gov.uk/science/documents/publications/2003/UseofModelsinDiseaseControlPolicy.pdf
- Murray N (2002) Import risk analysis: animals and animal products. New Zealand Ministry of Agriculture and Forestry, Wellington New Zealand.
- Murray N (2004) Introduction and Qualitative Risk Analysis, Vol 1. Office International des Epizooties, 59 p.
- Murray N (2004), Quantitative Risk Assessment, Vol 2. Office International des Epizooties, 126 p.

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Meeting 16: Economics

Reading

- Dijkhuizen AA and Morris RS (1997) Animal Health Economics: Principles and Applications. PGFVS, University of Sydney, Chapters 1-4.
- Pfeiffer, DU (1997) Decision making and risk analysis. In R.Ruppanner (ed.) Risk Analysis and Animal Health - A Course Manual. International Training Course, Dübendorf, Switzerland, July 13-18, 1997, 861-877. Available: http://www.vetschools.co.uk/EpiVetNet/risk_analysis.htm
- Thrusfield 2nd Edn or 3rd Edn, Chapter 20 (economics of disease).

Presentations

1. Partial farm budgeting
2. Gross margins analysis
3. Decision trees and pay-off tables
4. Cost benefit analysis and cost effectiveness analysis
5. Sensitivity analysis

Exercises

1. Choose a management situation on a farm and as a group work out a partial farm budget for a particular change.
2. Choose an animal disease and as a group work through a pay-off table or decision tree for different treatment options.
3. An exercise in Decision Analysis: When is Coronary Angiography required in aortic valve replacement. Available: http://www.med.uiuc.edu/m2/epidemiology/dec_anal_2000/dec_anal_prob.htm

Example examination questions

1. Using examples write brief notes on the situations in which you would use partial farm budgeting and pay-off tables, the information you would need for each and the way you would interpret the results (2003 written).
2. Using examples write brief notes on the characteristics, application and limitations of cost-benefit analysis (2005 written).

Additional reading/resources

- Norton S, Groenendaal H and Heuer C (2005) Simulating control strategies for Johne's Disease on NZ dairy farms: effects on the prevalence and economic impact of disease. Proceedings of the Food Safety and Biosecurity and Epidemiology Branches of the NZVA, p.193-204.

- Swinkels JM, Zadoks RN and Hogeveen H (2005) Use of partial budgeting to determine the economic benefits of antibiotic treatment during lactation of chronic subclinical mastitis caused by Staphylococcus aureus. In: Mastitis in dairy production – current knowledge and future solutions, p. 217-223.
- Otte MJ and Chilonda P. Animal Health Economics: an Introduction. Available: http://www.fao.org/ag/aginfo/resources/en/publications/agapubs/pproc01.pdf
- Martin, Meek and Willeberg Chapter 9 (animal health economics)
- Stevenson MA, Frey B and Morris RS (1996) Decision Making in Veterinary Practice: Economics made easy. AAPV- NZPVS 2nd Pan Pacific Program; pp 57-64.

Meeting 17: Final revision

Particularly if you have not undertaken exams for a long time then the thought of sitting an exam can be nerve-wracking.

Revision strategies that you may find useful include:

- Holding additional group revision sessions to review previous meetings, paying particular attention to concepts or topics that you found difficult to understand
- Producing condensed summary of your notes from previous meeting for easy reference
- Attempting past exam papers under exam conditions. Past exam papers are available from the Australian College of Veterinary Scientists website http://www.acvs.org.au/.

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Meeting 18: Preparation for oral examination

Preparation for oral exams is difficult. It is suggested that you go through all the questions in the written papers that you have just attempted. The aim of this is to prepare for any questions at the oral that may arise from the written papers. Examiners may raise areas in the written exam where the answers were confused or incomplete and require clarification so that the examiners may fully assess the candidate's knowledge.

A series of practice questions are below.

These could be photocopied and cut into separate strips. Questions could then be randomly selected for individual group members to attempt.

Oral examination practice questions:

1. Give a definition of test Se, Sp, PPV, NPV and describe the effect of the prevalence of disease on these values.
2. How can you improve the PPV or NPV?
3. Describe the important attributes of screening tests
4. What are the important features of tests used at the beginning and the end of an eradication program? How might you improve the test performance at the end of the eradication program?
5. How would you compare two diagnostic tests?
6. What is the difference between precision and accuracy of diagnostic tests?
7. What is an ROC curve and what is it used for?
8. Define and give an example of a risk, rate, ratio and proportion.
9. Discuss the various sampling methods that can be used, their application, advantages and disadvantages?
10. What are the different types of data that may be collected? What are the most appropriate methods of presenting each type?
11. What are the application, advantageous and limitations of parametric and non-parametric test? Give 2 examples of each type of test.
12. Describe the application, advantages and limitations of meta-analysis.
13. Describe the application, advantages and limitations of survival analysis.
14. Describe the application, advantages and limitations of sensitivity analysis.
15. Describe the circumstances where collection of data on disease occurrence from an abattoir would be appropriate. What are the limitations of this method?
16. What response rate would you expect from a mailed-out survey? How could this be improved?
17. What type of bias is most likely to affect case-control studies?
18. What type of bias is most likely to affect cohort studies?
19. When perusing the AVJ or another veterinary journal what criteria do you use to critically assess the articles?

20. Define the null and alternative hypothesis.
21. What is a p value and how is it determined?
22. Define selection bias and what actions can be undertaken to prevent it?
23. Using the 2 X 2 table (below) show how to calculate RR, OR, AR and AF.

	D+	**D-**
E+	**a**	**b**
E-	**c**	**d**

24. What roles might an epidemiologist play on an Animal Ethics Experimentation Committee?
25. Your help has been sought to evaluate the efficacy of a new ovine footrot vaccine. The new vaccine has performed well in experimental challenge studies. What issues would you consider?
26. You are interested in the usefulness of leptospirosis serology in detecting renal colonisation with leptospires at the time of blood sampling. Consider the following data from a cross-sectional study of chopper dairy cows from Victoria. Cows were blood sampled at slaughter for leptospirosis serology and kidneys removed for extensive culture and other bacteriology for detection of leptospires.

Number of cows by serological result and renal leptospirosis status

Serological result		Renal leptospirosis status		
		+	**-**	Total
	+	550	250	800
	-	70	130	200
	Total	620	380	1,000

a) Calculate the following for the serological test: positive predictive value, negative predictive value, true prevalence, apparent prevalence, sensitivity, and specificity.

b) How would you expect the negative predictive value and positive predictive value of the serological test to change if the true prevalence was 1/10 of that observed in the current study? Recalculate both of these using the table for 1,000 cattle as above, with the true prevalence 1/10 of that shown above.

27. Authorities in Australia plan to introduce a valuable bull from a country where several diseases exotic to Australia occur either sporadically or endemically. Diagnostic tests will be used to assess the bull's status for each disease of concern. How important are positive predictive value and negative predictive value to the Australian authorities.
28. How might an importing country reduce the risk of introducing infectious disease in imported animals?
29. Despite accepting horses from countries where equine influenza has occurred, Australia does not want to introduce the virus. What issues do you need to consider before undertaking a risk analysis for the importation of horses from such countries?

30. Farmers consider that more cancer eyes are occurring in cattle in their region and are blaming the coal dust from the local coal mine. How would you investigate this?

31. How would you monitor the frequency of Johne's disease in a cattle population in a region of Victoria?

32. How might you prove that a region of Western Australia is free of ovine Johne's disease?

33. What are the pieces of information required to calculate sample sizes for:

    a) Estimating the prevalence of a disease in a population

    b) Detection of disease in a population, and

    c) A proposed observational study to investigate the association between a dichotomous exposure and a dichotomous outcome?

34. Some kangaroos in the Grampians National Park in Victoria are regularly fed bread by well-meaning tourists. Government rangers suspect that they see excess lumpy jaw amongst kangaroos fed bread. The results shown below are from a cohort study assessing the effect of bread feeding of kangaroos on the incidence of lumpy jaw. A total of 982 initially unaffected kangaroos were all observed for a 2 year period

    a) Which of the following indices can be appropriately calculated from this data? Odds ratio, relative risk, attributable rate, population attributable risk

    b) Where calculation is appropriate, calculate them.

Number of kangaroos observed and affected by lumpy jaw in a cohort study

		Number enrolled	New cases of lumpy jaw
Fed bread?	Yes	213	9
	No	769	7

    c) What statistical test(s) would be appropriate for analysis of this data?