

# Large Animal VETERINARY Rounds®

JUNE/JULY 2006  
Volume 6, Issue 6

AS PRESENTED IN THE ROUNDS OF THE DEPARTMENT OF LARGE ANIMAL CLINICAL SCIENCES  
OF THE WESTERN COLLEGE OF VETERINARY MEDICINE, UNIVERSITY OF SASKATCHEWAN

## Assessing Disease and Productivity - Critical Tools for Evaluating the Herd

By Cheryl Waldner, DVM, PhD

*"If I had wanted to work with numbers every day, I would have become an accountant."*

Although the desire to analyze data did not motivate most of us to enter veterinary medicine, practitioners providing routine herd consultation services, those investigating herd disease problems and production shortfalls, and those engaging in on-farm research require basic epidemiological and statistical tools to meet the increasing demands of their clients. Veterinarians who consult on herd management or clinical research need these tools to:

- assess trends in production and herd health
- evaluate risk factors for disease
- compare the effectiveness of different treatment protocols
- determine the impact of management changes.

The objective of this issue of *Large Animal Veterinary Rounds* is to review some basic epidemiological and statistical tools that may help veterinarians optimize the use of different types of available health and production data in making recommendations for clients. For more information, readers may consult a recent series of references examining the application of epidemiological and statistical tools in food animal practice.<sup>1-3</sup>

### Animal health and production data

Performance assessment and on-farm research are best done by someone who understands the herd and its management. Knowledge of the information source and the quality of records from each herd are essential for determining how the limitations and potential errors in the data will affect its usefulness in decision-making. The ability to recognize the different types of data available to address specific questions about herd health and performance is important. The types of data will determine how to best describe the information and evaluate change.

Data can be *categorical* (sex, breed) or *numerical* (age, days in milk, or average daily gain). Categorical data can be *nominal* (sex, breed) and simply describe a characteristic or attribute of the animal with no implied order, or the data can be *ordinal* (disease status, lameness score) and reflect some attribute or characteristic that can be ranked (no clinical signs, mild, moderate, or severe disease). Numerical data can be *discrete* (number of services per conception), where the values can only assume whole numbers, or *continuous* (daily milk production or weaning weight), where the data can have any value within a defined range.

### Describing data

A simple method to summarize or describe data is needed before a large set of individual animal records can be used effectively. A picture of the results is necessary to meaningfully interpret data and compare the results to other herds, to published benchmarks, or to evaluate changes over time; this should include a measure of both the midpoint and spread of the data.

### Graphing data

The first step when analyzing any set of numbers or herd records is to create a useful picture so you can carefully scrutinize the data. Running a statistical test without visualizing the data is like diagnosing a complicated case over the phone without an examination. Assumptions based on a brief history,



WESTERN COLLEGE OF  
VETERINARY MEDICINE



### Department of Large Animal Clinical Sciences Western College of Veterinary Medicine

David G. Wilson, DVM, Diplomate ACVS (*Editor*)  
Charles S. Rhodes, DVM, MSc (*Dean*)  
David G. Wilson, DVM, Diplomate ACVS  
(*Department Head*)

Ken Armstrong, DVM, Professor Emeritus  
Sue Ashburner, DVM  
Jeremy Bailey, BVSc, Diplomate ACVS  
Spence M. Barber, DVM, Diplomate ACVS  
Albert D. Barth, DVM, Diplomate ACT  
Frank Bristol, DVM, DACT, Professor Emeritus  
Ray Butler, DVM, Professor Emeritus  
John Campbell, DVM, DVSc  
Claire Card, DVM, DACT  
James L. Carmalt, VetMB, MRCVS, MVEtSc,  
Diplomate ABVP (Equine)  
Terry D. Carruthers, DVM, PhD  
Bill Cates, DVM, Professor Emeritus  
Chris Clark, VetMB, MVEtSc, Diplomate ACVIM  
Peter B. Fretz, DVM, Diplomate ACVS,  
Professor Emeritus  
Paul Greenough, DVM, Professor Emeritus  
Jerry Haigh, DVM, Diplomate ACZM  
John CS Harding, DVM, DVSc  
Steven H. Hendrick, DVM, DVSc  
Murray D. Jelinski, DVM, MSc  
Katharina Lohmann, DVM, Diplomate ACVIM, PhD  
Steve Manning, DVM, Diplomate ACT  
Fernando J. Marqués, DVM, Diplomate ACVIM  
Reuben J. Mapletoft, DVM, PhD  
Colin Palmer, DVM, Diplomate ACT  
Lyall Petrie, BVMS, PhD  
O.M. Radostits, DVM, Diplomate ACVIM,  
Professor Emeritus  
Fritz J. Schumann, DVM, MVEtSc  
Joseph M. Stookey, PhD  
Hugh G.G. Townsend, DVM, MSc  
Cheryl Waldner, DVM, PhD  
Murray R. Woodbury, DVM, MSc

### Western College of Veterinary Medicine Department of Large Animal Clinical Sciences

52 Campus Drive  
University of Saskatchewan  
Saskatoon, Saskatchewan S7N 5B4

The editorial content of *Large Animal Veterinary Rounds* is determined solely by the Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine



The Canadian Veterinary Medical Association recognizes the educational value of this publication and provides support to the WCVM for its distribution.

with luck, may provide enough information to pick the right answer; however, gaps in available information may lead to erroneous conclusions.

Depending on the type of software available, the simplest option for visualizing information is often a histogram or bar graph. Histograms can be used to describe almost any type of data. The graph depicts how many cases fall into the category or range of data represented by each bar on the graph. This allows a quick view of the range of values, where in the range most of the values lie, and whether more than one distinct grouping appears within the data. If there is more than one group in the data, care is necessary in summarizing the results. For example, taking an average titre from a group of calves where some have very high bovine virus diarrhoea virus (BVDV) titres (recent exposure) and others have no BVDV titres (either completely susceptible or potentially persistently infected [PI] calves), could mislead the interpretation as a single group of calves with moderate titres. This result could be interpreted as evidence consistent with vaccination or residual colostral antibodies.

### **Numerical data**

#### **Measures of central tendency**

The measure most commonly used to summarize numerical data or to describe a “typical” value is the mean or average value. Given that the data graph suggests a normal distribution, the average or arithmetic mean can provide a quick and easy way to understand representative values. However, a simple average is not appropriate for summarizing most types of discrete data (titres based on serial dilutions) or scoring data (body condition or lameness scores).

A less-commonly used alternative is the median. The median is the 50<sup>th</sup> percentile or the true mid-point of a series of numbers. This number is particularly useful when data are derived from a discrete scoring system or are substantially skewed. For example, values such as the somatic cell count or the calving-to-conception interval are almost never normally distributed. The average of these values in a dairy herd can be strongly influenced by a few problem cows; therefore, the median will provide a better representation of typical herd performance.

#### **Measures of variation**

A good description of data variability is just as important as the measure of central tendency discussed above. The most common method of measuring variability is the standard deviation (SD) and it provides much useful information for normally distributed data. In normally distributed data, it can be estimated that approximately 68% of the observations will fall within  $\pm 1$  SD of the mean, 95% within  $\pm 2$  SD of the mean, and 99% within  $\pm 3$  SD of the mean.

However, many types of veterinary data are not normally distributed; it may be skewed or have distinctive patterns revealing more than one group of interest within the herd. In these cases, it is necessary to use other methods to describe the spread in the data. For relatively large, skewed datasets, the interquartile range (25<sup>th</sup> percentile to the 75<sup>th</sup> percentile) or the middle 50% is a useful representation of the spread of data points. For very small datasets, the range or minimum and maximum values are often appropriate.

### **High vs low or normal vs abnormal**

For some sets of continuous data, more information may be gained by determining the percentage of animals with values above or below a particular threshold of interest or the percentage of values considered normal, abnormal, deficient, or toxic. For example, the proportion of deficient animals might be more useful than the herd average when evaluating whole blood selenium concentrations. In other cases, it makes sense to categorize the data into  $> 2$  groups and report a frequency distribution. For example, while average cow age gives very limited information, the percentage of first calf heifers, second calving, mature cows, and old cows provides a more readily interpretable picture of the herd.

### **Categorical data**

#### **Proportions and odds tendency**

Frequency distributions are also used to describe categorical data. For example, the percentage of male and female calves might be reported. Frequency data is often summarized using proportions. When reporting proportions, the numerator is always included in the denominator and the denominator is the total number of animals at risk. Proportions are also used to describe the probability that some event could occur.

The occurrence of disease can also be described by reporting the odds of the event, ie, the ratio of individuals in a group to those who are not. For example, the odds of a calf dying before weaning might be 1:24. For every calf that dies, 24 will survive. This is not the same as a probability because the numerator is not included in the denominator. To convert this to the probability of a calf dying before weaning, the 1 would be included in the denominator to get  $(1/[24+1])$  or 4%.

#### **Prevalence and incidence**

*Prevalence* can be used to describe the occurrence of disease in a herd. The most commonly reported type of prevalence summarizes the total number of cases present at a particular *point in time* as a percentage of the total number of cases at risk for the disease at that time. The point prevalence of scours could be the number of calves in the herd with clinical signs of scours as a percentage of the total number of live calves counted during a single herd visit.

*Incidence* describes the occurrence or probability of new cases of disease. The simplest summary method is to report the number of new cases during the *period of interest* as a percentage of the number of animals at risk of becoming a new case during that time (*cumulative incidence* or *attack rate*). Animals with the condition or disease at the start of the period are not included in the calculation. Cumulative incidence can be used to describe the risk of event during a defined period.

Cumulative incidence is often reported when summarizing disease or production parameters in cow-calf herds. For example, the stillbirth risk in the herd could be defined as the number of calves born dead as a percentage of the total number of calves born dead or alive during the complete calving season. This calculation works well when the period of interest and population at risk are clearly defined, when there is little animal movement in and out of the herd during the period,

and when all animals are at-risk for the event for the same period of time.

Cumulative incidence would not work as well in defining the frequency of milk fever in a dairy herd during one calendar year. In most dairy herds, cows calve year round, the cows are culled at different times, and some cows do not calve each year; as a result, not all cows from a herd will be at risk of developing milk fever for the same number of days during a 1-year period. Therefore, cumulative incidence is not the best way to summarize this information; instead, the use of incidence density may be considered. Incidence density examines the number of new cases of milk fever during the period, but the denominator is determined using the number of days each cow was at risk of developing clinical signs. By describing the number of new cases per animal time unit at risk (cow-days-at-risk), in this manner, the result can be referred to as the rate of disease.

### Examining differences across groups

The effect of management practices, treatments, or other risk factors can be assessed by comparing animals, pens, or herds with and without the factor of interest using appropriate analytical methods. For example, it may be of interest to compare the rate of (weight) gain in calves exposed to the BVDV virus to calves not exposed. The first step is to examine the results for the outcome variables measured in each management or treatment group. The description would include the distribution of the rate of gain in seropositive calves and in seronegative calves. The occurrence of other herd or animal attributes that might have influenced the outcome of interest should also be summarized for each group. For example, the sex and age distribution of positive and negative calves could be determined. The data are examined to make sure there are no previously undiscovered errors in data entry and to understand the range and distribution of each type of data. This is necessary to select the best type of statistical analysis for the question.

Statistical analysis is used to measure the strength of the association between the factor being studied (treatment or management practice) and each outcome variable of interest. The analysis also estimates the probability that any difference between the exposure or treatment groups could be due to chance and defines the level of uncertainty in the result.

#### *Type I and Type II error*

There are two possible types of chance-related or random errors:

- **Type I error** occurs when there really is no association between the risk factor being evaluated or the treatment being tested and the outcome of interest; however, because of random sampling error there appears to be an association in the data sample (a false positive study finding).
- **Type II error** occurs when there is a failure to identify an association that really does exist (a false negative study finding). This usually occurs because the sample size was not large enough to thoroughly examine the study question.

An appropriate statistical test provides a *P*-value and confidence intervals that can be used to assess the likelihood or probability of these types of errors in the final result. The *P*-value, defined loosely, is the probability that the results of the

statistical analysis could have arisen by chance alone. For this value to be meaningful (that is, to go a step further and suggest the likelihood that the measured association arose by chance alone), the correct statistical test for the question must be selected and applied correctly to the data. The *P*-value is used to help assess the probability or chance of a type I error in the results. If the statistical analysis was appropriate and if  $P < 0.05$ , then there is <5% probability or <1 chance in 20 that the reported effect of the factor under study was due to chance alone.

When asking a single question and doing the associated statistical test, a 5% probability of a type I error is usually considered acceptable. However, the likelihood of a false positive result increases with each additional analysis. For example, with 6 tests, the combined probability of a type I error is >1 in 4. When large numbers of *P*-values are reported from a single study, one must consider that some or all of the significant results could be due to type I errors unless the authors clearly state what was done to minimize this potential problem.

#### *Validity of the statistical test – choosing the correct test for the question*

The best statistical test for any question depends on both the type of outcome data and the methods used to measure the exposure or to distinguish the treatment groups (nominal, ordinal, discrete, or continuous; Table 1). Although, the advice of an epidemiologist or statistician should be requested for complicated data, there are several tables and flow charts published in introductory statistics texts that can be used as a guide to the correct test for relatively simple questions. Most statistical software packages also contain guidelines on selecting the appropriate test; however, several important issues are often overlooked in choosing the right test for the data.

#### *The assumptions of the test*

Most statistical tests are based on at least some assumptions about the data. If the assumptions are not met, then the resulting *P*-value from the test is meaningless. When there are assumptions about the distribution of the data, the test is referred to as parametric. For example, the *t*-test is commonly used to compare differences in continuous outcome measures across 2 groups (eg, daily milk production for 2 different rations). If both groups are normally distributed and have approximately the same variance, then a *t*-test is appropriate. If these distributional assumptions are not met, alternative methods (non-parametric methods) should be considered. In this example, a Wilcoxon rank sum test might be appropriate.

In addition to the method-specific assumptions similar to those listed above for the *t*-test, there is one stipulation that applies to most of the commonly used tests. The observations must be independent; ie, knowledge about the outcome value for one observation says nothing about the next observation in the data set.

There are two important examples where the independence assumption is commonly violated in veterinary data. The first is a collection of >1 observation per subject or repeated measurements on individuals or herds over a period of time. The simplest form of a repeated measure statistic is the paired *t*-test. There are many other methods designed for complicated analyses.

**Table 1: Examples for choosing the appropriate test**

|  |                              | Independent variable (X)<br>(the risk factor of interest)  |   |
|--|------------------------------|--|---|
|  |                              | Quantitative<br>(continuous)                               | Qualitative<br>(categorical)  |
| Dependent Variable (Y)<br>(the outcome variable) | Quantitative<br>(continuous) | Linear regression<br>Correlation<br>Spearman's Correlation | T-test<br>Paired T-test<br>ANOVA's<br>Wilcoxon rank sum<br>Wilcoxon signed rank |
|  | Qualitative<br>(categorical) | Logistic regression  | Chi-square<br>Fisher's exact test<br>McNemar's test                             |

The second place where violations of the independence assumption are likely is in data collected from individuals managed or treated as groups, for example, in a series of pens or herds. Cows within the same herd or calves within the same feedlot pen probably have more in common with each other than they do with animals in other herds or pens. Special types of analyses are needed to account for the expected similarity or clustering of responses within these groups.

### Statistical vs biological or clinical significance

When differences between treatment or risk factor groups are statistically significant, it does not mean that these differences are biologically or clinically important. The *P*-value is dependent on not only the size or clinical significance of the differences between treatment or risk factor groups, but also on the number of observations considered in the analysis. Very small and potentially unimportant differences can be statistically significant if the sample size is very large. Very large and important differences may not be statistically significant if the sample size is too small.

To determine the clinical significance of the association, the size of the potential effect or the difference between the treatment groups is measured. If the outcome variable is continuous, the absolute amount of the difference between the groups is calculated. We can then determine if that difference is clinically important. The results of a statistical test should not give just the *P*-value, but should also reveal the magnitude of difference. For example, the absolute difference in average milk per cow per day (kg) could be reported when comparing milk production for 2 different total mixed rations.

When the variable of interest is categorical (eg, whether the animal does or does not have a disease), the relative difference in frequency of disease between groups can be estimated. For example, one might report how many times more likely a calf from a heifer is to be still-born than a calf from a mature cow.

### Relative risk and odds ratio

The magnitude of the association between each risk factor or treatment and the outcome of interest or disease can be reported using a relative risk (RR) or odds ratio (OR; Table 2).

The *relative risk* is the ratio of the risk (cumulative incidence or attack rate) of disease in the animals exposed to the factor of interest, to the risk (cumulative incidence or attack rate) of disease in those not exposed. If the relative risk is  $<1$ , then the exposure is associated with a decreased risk of disease. If the relative risk is equal to 1, then there is no association between exposure and disease status. If the relative risk is  $>1$ , then the exposure is associated with an increased risk of disease. The relative risk is appropriate when all individuals in the herd are included, or the sample was collected randomly and selection was not based on disease status.

The *odds ratio* can be used to measure the association between exposure and disease for any study type. The OR, for the purposes of this discussion, expresses the relative difference in the odds of occurrence of the outcome of interest in one treatment or risk factor group to that in another. The odds ratio is the method of choice for expressing the magnitude of effect in case-control comparisons where the history of exposure to a specific risk factor is compared between case and control animals. The working interpretation of the odds ratio is similar to that of relative risk. The odds ratio is often reported because it is easily calculated from the results of logistic regression, a popular method for analyzing disease data.

### Confidence intervals

Confidence intervals can be used to provide a range of uncertainty around the estimate of the effect size. The level of uncertainty will be influenced by the number of observations and the amount of variability in the data for each of the groups being compared. Confidence intervals have an advantage over *P*-values in that they can be used to help understand the probability of both type I and type II errors.

**Table 2: Determining the relative risk or the odds ratio**

|             | Diseased                | Non-diseased                |                            |
|-------------|-------------------------|-----------------------------|----------------------------|
| Exposed     | a                       | b                           | a + b<br>(all exposed)     |
| Non-exposed | c                       | d                           | c + d<br>(all non-exposed) |
|             | a + c<br>(all diseased) | b + d<br>(all non-diseased) |                            |

Relative risk =  $[a / (a + b)] / [c / (c + d)]$   
 Odds ratio =  $[(a / c) / (b / d)]$  or  $[(a / b) / (c / d)] = ad / bc$

Confidence intervals are calculated to express the range of effect sizes that could have resulted given the sample size and variability in the data. To assess the risk of type I error, the confidence intervals are examined to see whether they include the possibility that there is no effect (ie, an effect size of zero) or an equal risk of the event in exposed and unexposed groups. If the confidence interval includes the potential for no effect then the result is not statistically significant ( $P > 0.05$ ) and the risk of type I error is  $> 5\%$ .

The width of the confidence interval also provides important information about the potential for type II error. If there is no difference or almost no difference in the outcome of interest between groups and the confidence intervals are narrow, it can be stated with some certainty that there is no substantial effect of the exposure or treatment studied. With narrow confidence intervals, it is very unlikely to miss finding a true association in the data because the sample size was too small (ie, there is a small probability of a type II error). However, if the confidence intervals are very wide and include the potential for no effect, then the possibility of missing an important association cannot be ruled out. There is the potential for a type II error and one cannot state with any certainty that the sample size was large enough to distinguish a real difference between groups.

Confidence intervals can be calculated for both absolute and relative estimates of effect. If examining absolute differences between groups, the confidence intervals can vary from any negative number through zero to any positive number. An absolute difference of 0 between groups suggests no effect. For example, for measuring a difference in daily milk production reported in kg, a 95% confidence interval containing 0 would be the same as reporting  $P > 0.05$ .

Confidence intervals can also be calculated for relative risks and odds ratios. In this case, there is a comparison of the occurrence of disease or an event in one group relative to another. To determine relative risk, the risk in one group is divided by the risk in the other group. Therefore, the confidence interval for an RR or an OR can be any positive number. A relative difference of 1 occurs when the risk in the two groups is the same. If the confidence interval for an RR or an OR includes 1, there is no significant difference between the two groups.

To recap, the final product of a statistical analysis should include either an absolute or a relative measure of the difference in the outcome (the effect estimate), a measure of uncertainty around that estimate (the confidence interval) and, finally, the probability that the estimated exposure effect is due to chance or random sampling error (the  $P$ -value).

### Association vs causation

Even if the analysis is appropriate, a statistically significant association alone does not prove the risk factor caused disease or that the therapy being assessed was a successful treatment. Before determining if the association is causal, it is necessary to assess whether some systematic bias is responsible for the difference between the groups. Bias tends to be less of a problem in a well-designed clinical trial than in an observational study. When examining the results of a clinical trial, first, confirming that the treatment was randomly assigned and, second, that the observers were blinded when measuring the outcome, will minimize the potential for bias in the results. In observational studies, more care is necessary to ensure that differences in the group selection or in the measurement of effects do not account for the findings. Finally, it is necessary to evaluate whether or not there was some other factor than the one of interest that differed between the groups and caused the apparent effect. Confounding, or the mixing of effects that may result from a failure to account for other important factors, can appear to either inflate or sometimes hide associations in the data.

Given that there is a statistically significant difference between groups and that the difference between the groups is not caused by some apparent source of bias or confounding, it is now possible to determine if the factor being studied is actually causing the difference. For a factor to be considered as a potential cause of disease or sub-optimal productivity, it is necessary to verify that the risk factor actually preceded the outcome in time; the cause cannot follow the effect. Other supporting evidence for a causal association could include:

- a relatively strong association between the risk factor and the outcome (less likely to be due to unmeasured confounding)
- a suggestion of increased effect with increased exposure (dose-response)
- a biologically reasonable link between risk factor and outcome (potential mechanism)
- a consistency of the association when examined in different groups or by supporting evidence from other studies.

### Conclusion

This overview contains only a very brief introduction to some of the issues that need to be considered when evaluating and reporting data from client herds or in clinical research. For those who are interested, more information is available in the references listed at the end of this summary.

---

**Dr. Waldner** is an Associate Professor in the Department of Large Animal Clinical Sciences at the Western College of Veterinary Medicine. She is actively involved in research examining the factors affecting the health and productivity of cow-calf herds in western Canada. Her current research includes BVDV, Neospora, antimicrobial resistance in cow-calf and swine operations, Salmonella infections in swine barns, and WNV. Dr. Waldner teaches outbreak investigation and epidemiology to veterinary students, and epidemiology and statistics in the graduate program. Before returning to the WCVM to teach in 1999, she worked in private practice and consulting in Alberta.

---

#### References

1. Ruegg P, ed. Barnyard Epidemiology and Performance Assessment. *Vet Clin North Am Food Anim Pract* 2006; 22(1): 279 pp.
2. Radostits OM, ed. *Herd Health: Food Animal Production Medicine*, 3<sup>rd</sup> Ed. Philadelphia: WB Saunders; 2001; 608 pp.
3. Petrie A, Watson P. *Statistics for Veterinary and Animal Science*. Oxford: Blackwell Science; 1999.

## Abstracts of Interest

### Basic epidemiologic concepts related to assessment of animal health and performance

RUEGG PL.

Modern animal production systems are increasingly complex, which is why farmers depend on veterinarians to help them make sound decisions based on valid interpretation of data. While serving as advisors to farmers, veterinarians face the challenge of properly identifying key indicators of animal performance and differentiating between values that reflect normal biologic variation and those that require intervention. The veterinary consultant must understand the strengths and weaknesses of data, assess production trends accurately, and evaluate the results of management changes. This article describes some basic epidemiologic concepts about animal performance data. These concepts equip veterinary practitioners with the tools they need to give the best advice.

*Vet Clin North Am Food Anim Pract* 2006;22(1):1-19.

### Disease outbreak investigation in food animal practice

WALDNER CL, CAMPBELL JR.

In addition to excellent observation skills and a good understanding of production medicine, veterinarians require the tools of epidemiology for the successful investigation of disease outbreaks. Food supply veterinary practitioners are often called upon to investigate various types of disease outbreaks. In this article, the authors outline the primary questions a practitioner should address and summarize a systematic approach to determining the causes of an outbreak and minimizing further losses. The investigation of disease outbreaks provides an opportunity for the herd veterinarian to show clients the advantages of a herd health program and the value of a good record-keeping system.

*Vet Clin North Am Food Anim Pract* 2006;22(1):75-101.

## Upcoming Meetings

22 – 26 August 2006

**Society for Theriogenology (SFT)/ American College of Theriogenologists (ACT) Conference and Symposium**  
St. Paul, Minnesota  
Contact: [therio.org](http://therio.org)

17 – 21 September 2006

**International Veterinary Emergency and Critical Care Symposium**  
San Antonio, Texas  
Contact: [www.veccs.org](http://www.veccs.org)

21 – 23 September 2006

**39<sup>th</sup> Annual Convention of the American Association of Bovine Practitioners**  
Saint Paul, Minnesota

Suggested workshops:

Applied Epidemiology in Bovine Practice - Level I,  
September 19, 2006

Applied Epidemiology in Bovine Practice - Level II,  
September 20, 2006

Website: [www.aabp.org](http://www.aabp.org)

15 – 19 October 2006

**24<sup>th</sup> World Buiatrics Conference**  
Nice, France

Contact: Service Gestion des congrès

Tel: 00 33 (0)4 93 92 81 61/58

Fax: 00 33 (0)4 93 92 83 38

E-mail : [wbc2006@nice-acropolis.com](mailto:wbc2006@nice-acropolis.com)

Website: [www.wbc2006.com](http://www.wbc2006.com)

---

*Dr. Waldner has stated that she has no disclosures to announce in association with the contents of this issue.*

Change of address notices and requests for subscriptions to *Large Animal Veterinary Rounds* are to be sent by mail to P.O. Box 310, Station H, Montreal, Quebec H3G 2K8 or by fax to (514) 932-5114 or by e-mail to [info@snellmedical.com](mailto:info@snellmedical.com). Please reference *Large Animal Veterinary Rounds* in your correspondence. Undeliverable copies are to be sent to the address above. Publications Post #40032303

---

This publication is made possible by an educational grant from

## Schering-Plough Animal Health

---

© 2006 Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine, which is solely responsible for the contents. The opinions expressed in this publication do not necessarily reflect those of the publisher or sponsor, but rather are those of the authoring institution based on the available scientific literature. Publisher: SNELL Medical Communication Inc. in cooperation with the Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine. <sup>®</sup>*Large Animal Veterinary Rounds* is a registered trade mark of SNELL Medical Communication Inc. All rights reserved. SNELL Medical Communication Inc. is committed to the development of superior Continuing Medical Education. The administration of any therapies discussed or referred to in *Large Animal Veterinary Rounds* should always be consistent with the recognized prescribing information in Canada.