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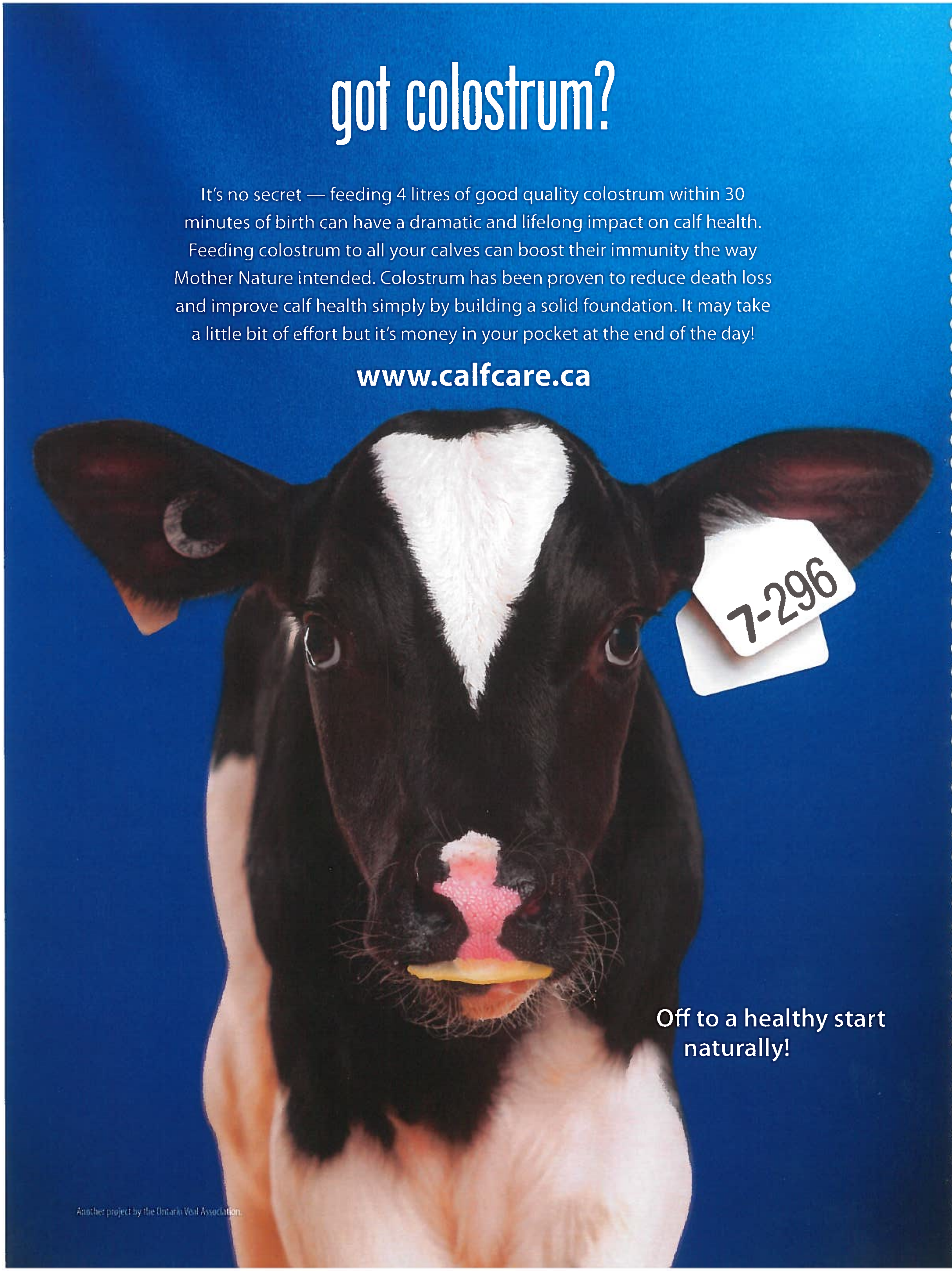
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Dairy and Veal Healthy Calf Conference **2008**

WELCOME

Dear Conference Participants,

We all know that raising calves can be challenging for both dairy and veal producers. Calf mortality and morbidity translates to high financial losses in both the dairy and veal industries. But there are tools we can learn to help us manage these challenges.

The Ontario Veal Association (OVA) is pleased to once again organize and present the third, biennial *Building the Foundation: Dairy and Veal Healthy Calf Conference*. This conference aims to provide both dairy and veal farmers with practical information they can implement on their farms to improve calf health and quality. By organizing these conferences the veal and dairy industries are working towards the same goal of improving the quality of bull and heifer calves.

This year's conference brings together an exceptional line up of speakers that both dairy and veal producers can learn practical, hands on tips for raising strong healthy calves. Thank you to our speakers for joining us today and sharing your insight and experience.

A special thank you to all of our industry partners who have graciously provided sponsorship and support for this important educational event. I hope that you will be able to speak with the many representatives in attendance today to help find solutions for your operation.

On behalf of the Ontario Veal Association, I welcome you to the third biennial Healthy Calf Conference.

Sincerely,

Judy Dirksen

OVA President

For more information on the Ontario Veal Association or to become a member contact the OVA office at 519-824-2942

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Dairy and Veal Healthy Calf Conference **2008**

AGENDA

THURSDAY DECEMBER 4th, 2008
London Convention Centre

8:30am Registration, morning refreshments and tradeshow

9:00am Welcome and opening remarks

9:10am **Dairy calf outlook: Research, trends and future developments**
Dr. Ken Leslie and Team, University of Guelph

9:45am **Weaning calves: Why are there so many challenges?**
Dr. James Drackley, University of Illinois

10:45am ***Mycoplasma bovis*: Take control!**
Dr. David Francoz, Université de Montréal

11:45am **Lunch & Tradeshow**

1:30pm **Managing group housing for calves**
Dr. Dan Weary, University of British Columbia

2:30pm **CSI-Guelph: Lessons to be learned from post mortem investigations**
Dr. Maria Spinato, OVC, University of Guelph

3:30pm **Adjourn**

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Dairy and Veal Healthy Calf Conference 2008

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Thank you to all our industry partners for your continued support of the Healthy Calf Conference!

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Thank you to our sponsors for their ongoing support of this important educational and industry event.

Dairy Calf Outlook: Research, trends and future developments

Under the direction of Dr. Ken Leslie, the Dairy Health Management Team at the University of Guelph has developed a comprehensive research program dedicated to calf health and management. This new research program has four major theme areas. The first theme is related to the overall well-being of the calf. The second theme area of study has been to assess new programs for the prevention of respiratory disease and ear infections in young calves. The third major theme area is to evaluate calf feeding strategies from birth until weaning. The final theme is a comprehensive calf health and management project. This project has enrolled approximately 2500 calves from Ontario dairy farms to assess their general health and physiological status at birth, the impact of genetic influences on their health, and the efficacy of various vaccination strategies on the incidence of disease, and on performance. Dr. Leslie and his research team will be discussing current research and what this means for your farm now and in the future.

Dr. Ken Leslie

Dr. Ken Leslie was raised on a central Ontario dairy farm. He graduated from the University of Guelph, Ontario Veterinary College in 1974, and developed bovine practice skills in Brampton, Ontario. After accepting a clinical faculty position at the Ontario Veterinary College, he completed his M.Sc. graduate training in dairy cattle reproductive management. Dr. Leslie is currently a full professor in the Department of Population Medicine, with the Ruminant Health Management Clinic. He has an international reputation and responsibilities for research, teaching and extension in the area of dairy health management. Dr. Leslie is currently the Dairy Research Coordinator for the University of Guelph OMAFRA Research Programs.

Dairy Calf Health Research at the University of Guelph: Management Programs for Calf Well-Being and Disease Prevention

Ken Leslie, Claire Windeyer, Lynsay Henderson, Cindy Todd, Kim Waalderbos, Amy Stanton, Vivianne Bielmann, and Brian Nelson
Department of Population Medicine, University of Guelph, Guelph, Ontario

Intoduction

Maintenance of calf health and well-being continues to be a formidable challenge for dairy farm managers in North America. There are a limited number of population-based studies that have reported on calf health and survival. A recent survey of US dairy herds found that 8% of calves die between birth and weaning, and that the incidence of diarrhea and pneumonia during this time period is around 24% and 12%, respectively (NAHMS, 2007). Current methods to prevent respiratory disease and neonatal calf diarrhea complex by housing, nutrition and vaccination programs are often not effective. There is a growing body of evidence that neonatal disease has many long-term impacts on the growth and productivity of calves, well beyond the period of clinical illness. Calves diagnosed with bovine respiratory disease (BRD) in the first three months of life were 2.5 times more likely to die after three months of age. Calves diagnosed treated for scours before three months of age were 2.5 times more likely to be sold as non-dairy animals and 2.9 times more likely to calve after 30 months of age (Waltner-Toews *et al,* 1986a). Furthermore, there is evidence that BRD in neonatal calves has a long-term impact on time to first calving and dystocia rates (Warnick, 1994). There is an on-going need for field evaluation of novel vaccines and vaccination strategies, as well as other management programs, to better prevent respiratory disease in young calves, to gain these long-term effects.

Neonatal calf diarrhea complex is clearly the most prevalent calf health issue in North American dairy herds. Research in Ontario and New York State has recently clarified the importance of *Cryptosporidia parvum* as a calf health problem. Prevention and therapy of this issue is a major challenge. However, risk factors for this infection and its relevance to human health have been identified. A major new finding related to diarrhea in dairy calves has been to characterize the pain and discomfort involved in this condition. Medical management of this pain has resulted in significant improvements in well-being, starter intake, weight gain, and behavioural measures of comfort. Other nutritional approaches to reduce these health problems and improve calf well-being are currently being investigated. These approaches include evaluation of free-access acidified milk feeding programs, supplementation of milk replacer for young calves with dried bovine colostrum, and supplementation of first-feeding colostrum with selenium. Another aspect of improvement of calf health is to evaluate the genetic associations with various measures of health and survival. There is preliminary evidence of significant variability between Holstein sires for survival to weaning in dairy replacement heifer calves.

The dairy industry in North America, and the scientific community supporting this industry, will undoubtedly face increasing scrutiny relative to dairy calf welfare issues. The dairy industry will not remain immune from questions that other food animal sectors have faced. It will be imperative that prevention of pain and receive greater attention in the future.

Acidified Milk Feeding Program

Recently, there has been more attention directed at the frequency and volume of whole milk or milk replacer fed to pre-weaned calves. There is a growing body of evidence that free-access milk feeding (also referred to as *ad libitum* milk feeding) supports improved performance and allows calves to engage in a more natural way of feeding. Jasper and Weary (2002) reported that calves with *ad libitum* access to milk consumed significantly more milk ($p<0.001$) and had improved pre-weaning weight gain ($p<0.001$) over conventionally-fed calves. Appleby *et al* (2001) have also shown that calves offered *ad libitum* milk by a teat-based system gained significantly more weight during the first 4 weeks of life ($p<0.01$), but consumed less starter ration ($p<0.001$), as compared to conventionally-fed calves. The feeding behaviour of the teat-fed calves was also described in this study, and it reported that there was considerable variation in the rate of milk intake and the size of milk meals. Also, calves took their largest and fastest meal following the delivery of fresh milk in the morning and afternoon.

Milk quality can become an issue in free-access feeding systems. Depending on the set-up of the feeding system, milk can sit unrefrigerated for many hours, leading to rapid and significant bacterial growth. For some time, Finlanders have been using formic acid to preserve milk, thereby enabling the practical and economical application of free-access feeding systems in dairy calf management. A diluted form of formic acid is used to acidify the milk to a pH of 4.0 to 4.5, because most bacteria and molds are unable to survive and reproduce within this range. Further information about the application of this free-access milk feeding program can be found in the OMAFRA Factsheet - Mimicking Nature's Way for Milk-Fed Dairy Calves: Free-Access Feeding with Acidified Milk, available at http://www.omafra.gov.on.ca/english/livestock/dairy/facts/mimick.htm.

In the late 1980s, several studies were published, examining the effects of free-access feeding with cold acidified milk replacer on the performance and health of dairy calves. However, all of these studies used acidified milk replacer of pH greater than 5.0. In one study, bull calves were offered either free-access to cold acidified milk replacer (pH = 5.27) or 10% of body weight of sweet milk replacer (Woodford *et al.*, 1987). The calves fed acidified milk replacer had significantly higher dry matter intake ($p<0.01$), lower fecal and abomasal pH ($p< 0.01$ and $p<0.01$, respectively) and decreased fecal dry matter ($p<0.05$), compared to sweet milk replacer-fed calves. The acidified milk replacer-fed calves also tended to have higher total body weight gain ($p<0.1$) and average daily gain ($p<0.1$) over the control calves. A second study reported that calves with free-access to acidified milk replacer had increased liquid dry matter intake ($p<0.0001$) over conventionally-fed calves (Nocek and Braund, 1986). Given the lack of published literature on the effects of free-access feeding using acidified milk of pH 4.0 to 4.5, there is a need for controlled research in this area.

A comprehensive research program has begun that will study the effects of free-access feeding using acidified milk of pH 4.0 to 4.5 on the growth, development, general health and behaviour of dairy and veal calves. For the first part of the research, a pilot study was conducted to examine the effects of free-access and acidified milk replacer feeding programs on starter ration, water and milk replacer intake, body weight gain, disease events, feeding behaviour and rumen development. In addition, a sampling of milk replacer was completed in order to determine the bacterial contamination of freshly delivered and acidified milk replacer.

The next phase of the research involves the collaboration of a commercial dairy and veal farm on a comparison of two milk replacer feeding programs. All heifer and bull calves born on the farm are raised as replacement heifers and grain-fed veal. The calves are systematically assigned at birth to be reared on one of two milk replacer feeding programs: free-access acidified milk replacer feeding versus restricted non-acidified milk replacer feeding. The team will evaluate differences in pre-weaning and post-weaning weight gain, slaughter weight, age at slaughter, carcass characteristics, disease events, mortality rates and the shedding of fecal pathogens.

Another component of this research program is an intensive controlled study to investigate the effects of free-access acidified milk replacer feeding on the health and performance of veal calves. The study calves are randomly assigned to free-access acidified or free-access non-acidified milk replacer feeding for the pre-weaning period. After weaning, all calves are transitioned to a grower ration. For each calf, information on disease events, health treatments, nutritional intake, pre-weaning and post-weaning weight gain, and time to market weight is collected. This study is expected to determine the importance of acidification of milk for successful implementation of free-access milk replacer feeding.

During the summer 2008, a herd-level observational cross-sectional study was conducted to describe the nutrition, health and management of pre-weaned calves on 140 Ontario dairy farms. A major goal of this effort is to assess the similarities and differences between farms that have adopted acidified milk feeding and farms that use traditional milk feeding programs for their calves. An intensive recruitment phase was conducted in March and April of 2008, ensuring that a large sample of Ontario dairy farms volunteered to participate in the study. The study involved a one-time farm visit, an interview about calf management on the farm, blood and fecal sampling of the current population of calves on the farm, as well as collection of calf growth information. All of the farm visits are complete and the trial data is being entered and analysis will soon be underway.

Finally, an economic analysis will be completed for free-access feeding using acidified milk. Data from the different parts of the research program will be used to develop a partial budget comparing traditional and free-access acidified milk feeding programs. This partial budget will be made widely available to producers in the veal and dairy industries. This research program has been supported by the Natural Sciences and Engineering Research Council of Canada, the Ontario Ministry of Agriculture, Food and Rural Affairs, the Dairy Farmers of Ontario, the Ontario Veal Association and Grober Animal Nutrition.

Prevention of Respiratory Disease

Bovine respiratory disease (BRD) results from an interaction between infectious agents, environmental stressors and host defenses. Several common viruses may contribute to BRD, including Bovine Respiratory Syncitial Virus, Parainfluenza-3 Virus, Bovine Viral Diarrhea Viruses, type 1 and 2, and Bovine Herpesvirus-1, the causative agent of Infectious Bovine Rhinotracheitis. Environmental factors such as temperature fluctuations, humidity, inadequate ventilation and poor hygiene may contribute to an increased incidence of BRD. (Lundborg et al, 2005; Sivula et al, 1996a; Van Donkersgoed et al, 1993; Waltner-Toews et al, 1986b). Furthermore, failure of passive transfer, malnutrition, and genetics are among the factors that may affect an individual calf's susceptibility to this and other diseases (Svensson, 2003; Van Donkersgoed, 1993; Waltner-Toews et al, 1986a). Although various improvements in calf management can be useful in reducing the incidence or severity of BRD in a herd, significant rates of disease still often occur.

Dairy producers have traditionally postponed vaccination replacement heifers against the viral agents commonly implicated in BRD until 6 months of age. This was due to the philosophy that maternal antibodies from colostrum interfere with a calf's ability to respond to the vaccine. Unfortunately, calves most frequently get sick with BRD during the post-weaning period, prior to their first viral vaccination. For this reason, an increasing number of producers have begun vaccinating their calves at various times in the pre-weaning period. There is an increasing body of research that indicates there may be some value in this practice (Woolums, 2007), however, to this point there has not been a large-scale field trial that evaluated the efficacy of pre-weaning vaccination in a dairy herd. The Calf Health Project will investigate the intramuscular administration of a five-way, modified live viral vaccine given to pre-weaned replacement heifers calves. They will be vaccinated at 2 weeks of age, 5 weeks of age or both these times, and compared to their unvaccinated counterparts. This study will examine the incidence of disease and other measures of general health, such as mortality, health score and growth performance, through and beyond the weaning period.

In times of stress immune suppression can occur, leaving calves vulnerable to infections (Carroll and Forsberg, 2007). For this reason, calves will often become ill following their first move from individual to group housing. At this time, they are required to adjust to a new environment with new pathogen challenges, their first exposure to a social hierarchy, and they are further challenged by recent changes in diet. Given these factors, it was decided to evaluate the use of a single injection of the antibiotic tulathromycin (Draxxin ®, Pfizer) administered at the time of movement from individual group housing on the incidence of BRD and growth in replacement heifers. This antibiotic product was chosen based on the fact that a single dose constitutes a complete course of therapy, and it provides activity in the lung for up to 14 days. As such, this treatment allows the calves to be protected during the immediate post-movement period, when they are at risk of immune suppression. This study was conducted on 1,393 commercial heifers at a large heifer raising facility in upstate New York. Calves were weaned at 6 weeks of age and moved into group housing at 8 weeks of age. At this time, they were treated with either Draxxin® or a previously established farm protocol using oxytetracycline. The calves were followed for 60 days post-enrolment for clinical respiratory disease and for growth. During this time period, 8% of Draxxin® treated calves and 13% of oxytetracycline calves were treated for clinical BRD in the follow-up period. Further analysis found that oxytetracycline treated calves were 1.8 times more likely to be treated for BRD than Draxxin® treated calves, $p<0.001$ (Stanton *et al*, 2008). Calves which were treated for fever between weaning and enrolment were 2.67 (1.12, 6.20) times more likely to be treated for BRD post-weaning, $p<0.05$. Calves were diagnosed with fever if they were dull, off feed, with an elevated body temperature without nasal discharge or elevated respiratory rate. In calves that had no diagnosis of fever in the pre-weaning period, Draxxin® treated calves weighed 4.9 +/- 1.4 kg more than oxytetracycline calves at 14 weeks of age, $p<0.001$. For calves that were treated for pre-weaning fever, there was no difference in weights between Draxxin® and oxytetracycline treated calves. Calves treated for clinical BRD in the 60 days following enrolment weighed 8.7 +/- 0.8 kg less than calves free of clinical BRD. There was no difference in mortality between the two groups in the 60 days following enrolment. These calves will be followed through their first lactation to determine the effect preventing post-movement BRD has on the age and size of heifers at breeding, rates of dystocia, milk production and culling rates. In conclusion, in specific herd situations, the use of a long-acting injectable antibiotic preparation after weaning can significantly reduce the incidence of respiratory disease, and improve growth and performance in replacement calves.

An assessment of calf health and genetic effects

During the first three weeks of life, approximately 20-35% of calves develop neonatal calf diarrhea complex, and a further 15-20% of calves have respiratory disease. These problems, in addition to other health issues, result in the death of roughly 5% of calves before weaning (Waltner-Toews et al, 1986a). However, these problems alone do not fully account for the substantial variation and unexplained occurrences of major calf health problems. It is distinctly possible that there are both management and genetic effects, which may be responsible for substantial variation in calf health.

To that end, the U of G Calf Health research team is assessing the health status of approximately 2,500 neonatal dairy bull and heifer calves from farms in southwestern

Ontario. The team is quantifying the transfer of passive immunity, as well as measuring health indicators in blood, including red and white blood cells, hemoglobin, hematocrit, selenium, total protein, magnesium and haptoglobin. The team is also evaluating any differences between heifer and bull calves for these health and blood indicators. At enrolment, calves are given a health score, measured for height, weight and body temperature, and two blood samples are collected. Birth records are completed for each study calf. Calves are tracked until four months of age for disease events, treatment status and weight gain.

Some preliminary data from a subset of the study has been analyzed. The research team has found that serum total protein values for 1,167 newborn calves ranged from 3.6 to 9.7g/dL, with a mean of 5.7g/dL. Successful passive transfer is considered anything above 5.2g/dL. To this point in the study, 229 calves (19.6%) have had failure of passive transfer. The distribution of whole blood selenium levels for 395 newborn heifer calves from 14 farms ranged from 0.15 to 0.27 μg/mL, with a mean of 0.22 μg/mL. Of note, the reference interval used to assess whole blood selenium status suggests that values should range from 0.20 to 1.2 μg/mL. At this preliminary stage in analysis, calves in this study tend toward the lower reference limit, with 140 calves (35.4%) falling below a 0.2 cut-off.

Selection for improved disease resistance is an element of genetics that has previously been overlooked. However, the genetic aspects of health is now a priority in dairy genetics research. So far, this research has concentrated solely on health traits in mature, lactating animals. Conversely, in 1989, Shook, G.E. suggested that because premature replacement of animals is a major component of disease cost, the economic value of disease should be evaluated on life cycle rather than lactation cycle performance. Therefore, this concept warrants the value of recording calfhood diseases. Furthermore, information on calf diseases may also provide potential early indicators of general disease resistance (Heringstad, B *et al.* 2008.)

The "Genetics of Dairy Calf Health and Survival" component of the "Calf Health" initiative will use data on the success of passive transfer of immunoglobulins, the occurrence of health problems and treatment for disease, as well as the overall survival of dairy calves up to weaning, for about 1,500 Ontario Holstein calves. Blood sample analysis, body weight data, disease events and other measurements are also being collected from the first few days of life until weaning. The parentage information on these Holstein calves will be used to determine the genetic associations with the above measured traits for calf health, as well as survival to weaning. The current study hypothesizes that there are genetic associations with health status of dairy calves in the early neonatal period, with susceptibility to neonatal disease problems, and with survival to weaning. Large differences in calf mortality between progeny of bulls as sires and as maternal grandsires have been previously reported (Martinez, M. *et al.* 1983, Lindstrom, U.B. and Vilva, V. 1977). These studies however, only followed survival though the first 24 hours of life (stillbirth). The current study will follow survival, as well as disease, until weaning age.

In addition to the prospective work in Ontario, a large database involving approximately 11,500 heifer calves reared at a commercial calf and heifer growing facility in New York State, will also be used for similar analyses of genetic impacts on calf health and survival. These data include success of passive transfer of immunity, weight measurements (at birth and weaning), as well as disease, treatment and survival information. The results of these analyses will provide preliminary evidence for the importance of genetic impacts on calf health and survival, and assist in building the Ontario calf database. Preliminary results from analysis of the New York heifer database indicate a significant sire effect on calf survival to weaning, (after controlling for source farm of origin, month of birth and year of birth). A noteworthy variance of 30% for survival to weaning was found between individual sires included in the analysis. Encouraging preliminary results indicate that selection for disease resistance and calf survival to weaning may indeed be possible.

Colostrum Supplementation Programs

Failure of passive transfer of immunoglobulins from colostrum is a problem for both the dairy and veal sectors. Calves with lower levels of passive immunity are more susceptible to disease, and have been found to have reduced daily weight gains in the first few months of life (Robison *et al.*, 1988). An increase in disease leads to higher production costs, increased use of antibiotics and decreased profitability for the producer.

Published research results from a Japanese study have indicated an increase in passive transfer of immunity of the dairy calf at birth, following oral supplementation of the first colostrum feeding with selenium (Kamada *et al.*, 2007). Selenium itself, has an important role in the immune response. Selenium supplementation of cattle has been shown to have a variety of effects, from improving udder through reducing the number and severity of mastitis cases (Erskine *et al.* 1989), to improving reproductive health resulting in a reduction in number of services per conception (Cortese, 1988). Selenium supplementation of deficient calves has been shown to reduce the incidence of diarrhea (Spears *et al.*, 1986), and to increase weight gain (Witchel *et al.*, 1996). As a result of the preliminary findings on the effects of selenium supplementation on passive transfer, and the previously published findings on neonatal diarrhea and weight gain, two selenium studies are planned for the calf health research team.

The first selenium trial has been designed to validate the findings of the Japanese research group, as well as to determine the relationship of selenium status between the dam, the colostrum and the calf. In this experiment, calves are randomly assigned to receive the addition of supplemental selenium or a placebo solution in their first colostrum feeding. The outcomes being measured are the passive transfer of immunoglobulins and the whole blood selenium levels. During the summer of 2008, approximately 120 cow calf pairs have been enrolled on this study at the Transition Management Facility of the University of Minnesota. Treatment group calves enrolled on this study receive an oral preparation of 3 ppm selenium, added directly to fresh maternal colostrum or colostrum replacer. Blood samples were taken from the dam and calf at birth to measure whole blood selenium levels, and from the calf 24 hours after its first colostrum meal to determine selenium and serum total protein. At the conclusion of this study, serum samples from these calves will be sent to the Saskatoon Colostrum Company's Laboratory for complete immunoglobulin analysis and quantification. Currently this project is ongoing.

The second component of the selenium research will consist of a larger field study, based on the findings of the pilot study. It will involve a large number of heifer calves in several Ontario commercial dairy herds. It will commence during the fall of 2008 to further evaluate the impact of selenium supplementation, either in the colostrum or through systemic injection, on the success of passive transfer, the incidence of diarrhea pathogens in feces, occurrence of calf health problems, and growth through to weaning. Enrollment of calves on this trial will begin in mid-Fall.

There is a recognized association between calf morbidity and mortality and low levels of maternal Ig transfer to neonatal calves (Pare et al., 1993; Donovan et al., 1998). The absorptive capacity of the calf's gut decreases exponentially within the first 24 hours after birth, however, immunoglobulin protein is not completely digested by the gastrointestinal tract allowing for speculation that dietary Ig may have protective properties while in the intestinal lumen (Brock et al., 1977).One practice that may help to reduce or eliminate the incidence of clinical enteric disease in neonatal calves known to have failed passive transfer of immunity is the provision of an exogenous source of Ig in the milk replacer. It is possible that providing an exogenous source of Ig to those neonatal dairy calves that are at the greatest risk for developing diarrhea may help to reduce or prevent the development of clinical disease caused by enteric pathogens. A series of 3 field trials conducted in California studied the effects of supplementing milk replacer over 14 days with 70 grams of Calf's Choice Total Bronze (CCT, Saskatoon Colostrum Co. Ltd.) twice daily. The study determined that supplementation with exogenous colostrum significantly reduced the odds of developing diarrhea and, consequently, the proportion of calves by 2 weeks of age that had yet to be classified as diarrheic (Berger et al., 2007).

An on-going trial is being conducted to determine the effect of supplementing milk replacer, being fed to dairy calves, with dried bovine colostrum during the first two weeks of life will decrease the incidence of neonatal calf diarrhea complex, and improve the overall health and growth of calves. All calves from the University of Guelph Elora Dairy Research Facility are enrolled onto the trial at birth. Between 18 and 30 hours after birth a preliminary blood sample is taken to determine the serum total solid level. The calves are randomly assigned to one of three different treatments: a control (milk replacer), milk replacer with 5g of immunoglobulins and milk replacer with 10g of immunoglobulins which they are fed twice daily. Milk, water and starter intakes are measured daily by the staff at the facility while body weight and fecal scores are measured weekly by a research technician. Fecal samples are taken at 3 different time periods and using BioX™ diagnostic kits, these samples are analyzed for the presence of *E. coli*, rotavirus, coronavirus and *Cryptosporidium parvum*. Currently, approximately 95 calves have been enrolled in the study since March 2008. Data collection is on-going and preliminary analysis of the data is in progress.

Management for Calf Well-Being and Prevention of Pain

Recent research has identified that management of acute pain at dehorning of dairy calves is largely neglected in the dairy industry (Mische *et al,* 2007). Use of local anesthesia and non-steroidal anti-inflammatories, during dehorning results eliminates the behavioural and physiological response to dehorning (Milligan et al, 2004) and should be used universally for this procedure. Furthermore, there is evidence that calf well-being is considerably improved with management of pain after dehorning (Milligan et al, 2004). Current research on post-weaning weight gain is identifying important behavioural and physiological differences in calves with high and low weight gain post-weaning (Stanton *et al,* 2008). Also, studies on middle ear infections are looking at the behavioural and biological impacts of this increasingly prevalent condition in dairy replacement calves.

Summary

In conclusion, there is an important need for implementation of documented successful methods of prevention of respiratory disease and diarrhea complex in young dairy calves. In addition, methods to alleviate the impact of these conditions, and improve calf well-being should be utilized. Finally, pain management for necessary procedures, and to improve overall calf well-being, should be given much greater attention.

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Weaning Calves: Why are there so many challenges?

When it comes to calf nutrition and weaning Dr. Drackley is one of the foremost experts. He has jointly written a book called "The Development, Nutrition and Management of the Young Calf". Dr. Drackley will present information for producers to help have a better understanding on what is going on metabolically during and after weaning with calves. Should we or should we not be feeding hay? What are the nutritional requirements of the calf at weaning and are they being met? What stresses are involved with weaning and why do the calves look so rough after weaning? Dr. Drackley will help producers have a better understanding of weaning and how it can be improved on farm.

Dr. James Drackley

Dr. Jim Drackley is Professor of Animal Sciences and Nutritional Sciences at the University of Illinois at Urbana-Champaign. Dr. Drackley grew up on a small dairy farm in Minnesota, and received his Ph.D. in Nutritional Physiology from Iowa State University in 1989. Since joining the faculty of the University of Illinois in 1989, his research program has focused on nutrition and metabolism of transition cows, lipid utilization and metabolism, and aspects of calf nutrition and management. Dr. Drackley has published extensively, has trained 27 graduate students, and has received numerous awards, including the 2007 Nutrition Professionals, Inc. Applied Dairy Nutrition Award from the American Dairy Science Association.

Funding for this presentation was provided in part by Agriculture and Agri-Food Canada through the Agricultural Adaptation Council's CanAdvance Program.

BUILDING THE FOUNDATION

Dairy and Veal Healthy Calf Conference **2008**

Weaning and the calf: Why are there so many challenges?

Jim Drackley

Professor of Animal Sciences
University of Illinois
at Urbana-Champaign

Weaning: The "other" transition period

- Two weeks before to two weeks after weaning
- One of the three critical stages of calf's life
- Impacts of stressors will not be as great again until the heifer calves

Outline of presentation

- Outcomes of weaning stress
- What is going on metabolically during and after weaning?
- What are the nutritional requirements of the calf at weaning and are they being met?
- How do we meet those requirements? Should we or should we not be feeding hay?
- What stresses are involved with weaning and why do the calves look so rough after weaning?
- What is the "ideal" weaning procedure?

Changes around weaning

- Diets
  - Removal of milk, total reliance on dry feed and free water, change from starter to grower
- Environment
  - Moving to different pen
- Social
  - Grouping with other calves
  - Removal of "surrogate mom" and suckling/milk feeding

Problems associated with weaning distress

- Growth slumps
  - Attributable to lower nutrient intake and stress
- Adverse behavioral stress
  - Vocalization, decreased resting

- Increased disease susceptibility
  - Particularly respiratory and coccidiosis
  - Impaired immunity due to suboptimal nutrition and weaning stressors
- Compromised welfare

Post-weaning mortality

- USDA-NAHMS 2007 survey: mortality of heifers after weaning was 1.8% of heifers born alive
- Respiratory disease accounted for 46.5% of these deaths

Chronic effects of respiratory disease

- Likely a much greater problem on most farms than mortality
- Calves with respiratory problem less likely to enter milking string, calved at an older age, had more dystocia, and were culled sooner
- Heifers with respiratory illness as calves: twice as likely not to calve, and calved 6 months later than those without respiratory illness as calves

Warnick et. al. I., 1995. J. Dairy Sci. 78.2819-2830.
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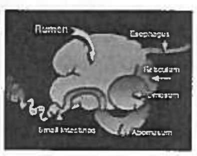
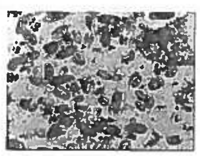
How does the calf's physiology change around weaning?





Basics of Digestion in Preruminant and Ruminant Calves

Overview: Digestion in the milk-fed calf

- Calf is a functional non-ruminant
- Enzyme systems for digesting non-milk proteins and starch are immature at birth
- System is designed to digest milk proteins, milk sugar (lactose), and milk fat
- Digestive capacity for non-milk ingredients increases over first 2-3 weeks

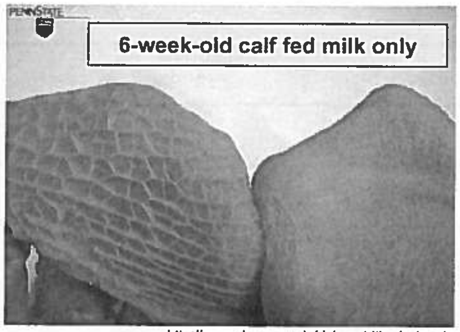
Absorbed nutrients in calves fed milk or milk replacer

- Glucose (from lactose): major body fuel
- Long-chain fatty acids (from fat): used for energy (minor) and storage as body fat (major)
- Amino acids (from dietary protein): used for body protein synthesis
- Minerals and vitamins: necessary for many vital functions

Transition to ruminant: Rumen fermentation begins

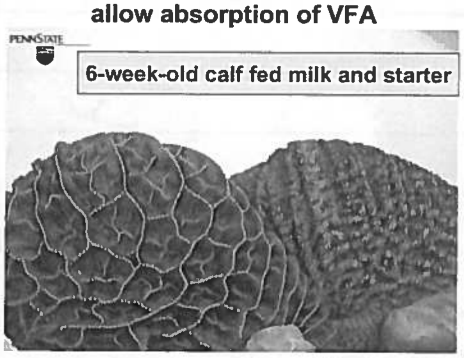
- Starches and sugars fermented in rumen to volatile fatty acids (VFA)
  - Acetate, propionate, butyrate
- Cellulose (fiber) fermenters inhibited by pH < 6
  - Until rumen pH increases and stabilizes, low ability to digest cellulose
  - Stimulation of rumen papillae growth by VFA helps to increase rumen pH as VFA are absorbed
- Degradation of dietary proteins in rumen
  - Ammonia production and blood urea increase

The absorptive lining of the reticulum and rumen is undeveloped at birth



http://www.das.psu.edu/dairynutrition/calves/rumen/

Reticulum and rumen lining develop to allow absorption of VFA



http://www.das.psu.edu/dairynutrition/calves/rumen/

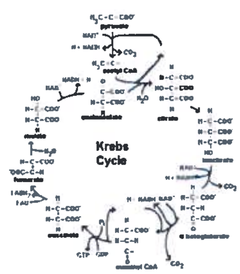
Digestion in ruminants

- Starch and cellulose fermentation provides the VFA acetate (main energy fuel) and propionate (main glucose source)
- Fermentation of carbohydrate and use of rumen degradable protein (RDP) results in microbial growth (microbial protein for host)
- Microbial protein supplies much of amino acid needs; remainder from rumen-undegradable protein (RUP)
- Sum of microbial protein and RUP is metabolizable protein (MP)

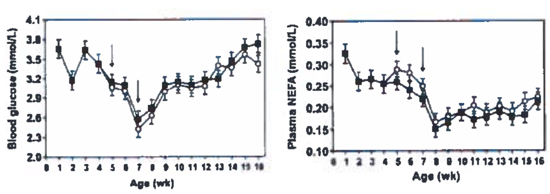
Absorbed nutrients in ruminants

- Acetate (from carbohydrate fermentation): major body fuel, major substrate for fat synthesis
- Propionate (from carbohydrate fermentation): major gluconeogenic precursor for blood glucose
- Butyrate (from carbohydrate fermentation): converted to ß-hydroxybutyrate (ketone body), used as fuel
- Long-chain fatty acids (mostly saturated, from dietary lipids) :used for energy (minor) and storage as body fat (major)
- Amino acids (from MP): used for protein synthesis

Metabolic changes around weaning



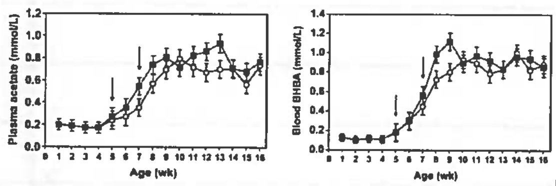
Blood glucose and NEFA decrease around weaning



Calves supplemented (open circles) or not (closed squares) with lasalocid

Klotz and Heitmann, 2006

Blood acetate and ketone bodies increase around weaning



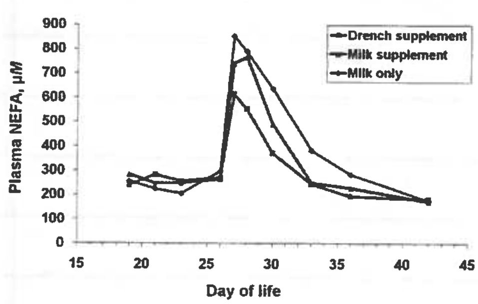
Calves supplemented (open circles) or not (closed squares) with lasalocid

Klotz and Heitmann, 2006

Why don't calves become ketotic?

- Increased ketone bodies come from rumen butyrate, not from mobilized body fat
- Blood glucose does not decrease like in cows with ketosis
- Overall energy balance is positive
- But…
  - Are there negative effects of high ketones? Decreased feed intake? Impaired immunity?

Plasma NEFA may increase sharply at weaning, indicating poor energy intake and/or stress

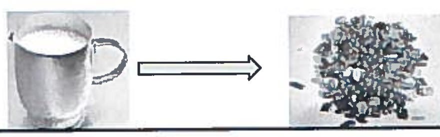


Luchini et al., 1993

What are the nutrient requirements of calves around weaning, and are they being met?

What are the calf's requirements?

- Tissue requirements for energy and protein (amino acids) do not change from preweaning to postweaning, if we want same growth rate!
- Problem is we must supply them from dry feed rather than milk…



Requirements for a 55-kg calf gaining 600 g/d

Feed	ME (Mcal)	ADP (g)
Milk and starter	4.02	180

Calf fed 20/20 milk replacer at 500 g/d and starter free choice (NRC 2001)

Requirements for a 55-kg calf gaining 600 g/d

Feed	ME (Mcal)	ADP (g)
Milk and starter	4.02	180

Calf fed 20/20 milk replacer at 500 g/d and starter free choice (NRC 2001)

Requirements for an 80-kg calf gaining 800 g/d

Feed	ME (Mcal)	ADP (g)
Milk and starter	6.02	246

Calf fed 28/15 milk replacer at 900 g/d and starter free choice (NRC 2001)

Starter dry matter intake (DMI) required to support various rates of gain in weaned calves

BW (kg)	ADG (g/d)	Starter required (kg/d)
60	600	1.53
60	800	1.90
80	600	1.80
80	800	2.18

Based on starter containing 3.1 Mcal ME/kg DM (NRC 2001)

NRC, 2001

Starter dry matter intake (DMI) required to support various rates of gain in weaned calves

BW (kg)	ADG (g/d)	Starter required (kg/d)

Because of differences in energy content of starter and its use by calves, we need 1.6 to 1.8 times more starter than milk replacer for same amount of body weight gain!

Based on starter containing 3.1 Mcal ME/kg DM (NRC 2001)

NRC, 2001

Is it any wonder that many calves slump in growth around weaning?

Example of growth slump: Experimental methods

- 89 Holstein calves born at UI dairy
  - 64 female, 25 male
- Treatments
  1. Conventional milk replacer plus conventional starter; n = 29
  2. Intensified (enhanced) milk replacer plus conventional starter; n = 31
  3. Intensified milk replacer plus intensified starter (higher protein); n = 29

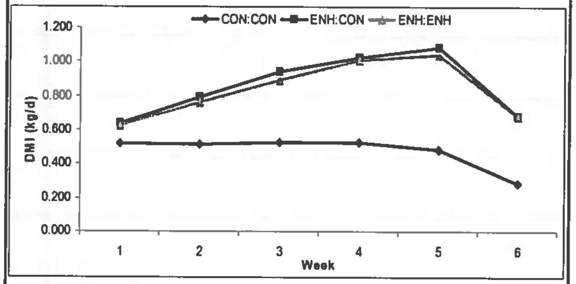
Stamey et al., 2005

Milk replacer feeding

- Intensified (Enhanced) Milk Replacer
  - Reconstituted to 15% solids
  - Fed at 1.5% of BW as DM during wk 1
  - Fed at 2% of BW as DM during wk 2 to 5
  - Fed at 1% of BW as DM once daily during wk 6
- Conventional Milk Replacer
  - Reconstituted to 12.5% solids
  - Fed at 1.25% of birth weight as DM daily in two feedings from wk 1 to wk 5
  - Fed at 0.625% of birth weight as DM once daily during wk 6

Stamey et al., 2005

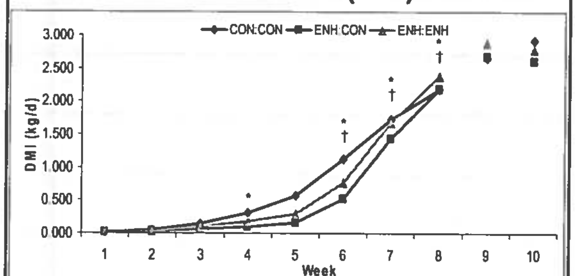
Milk replacer intake (DM)



Milk feeding rate: $P < 0.01$
Starter CP%: $P = 0.33$

Stamey et al., 2005

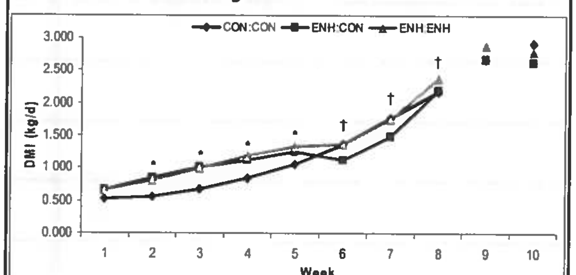
Starter intake (DM)



*Milk feeding rate x Week
†Starter CP% x Week

Stamey et al., 2005

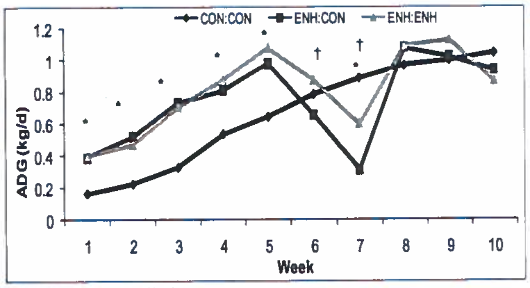
Total dry matter intake



*Milk feeding rate x Week
†Starter CP% x Week

Stamey et al., 2005

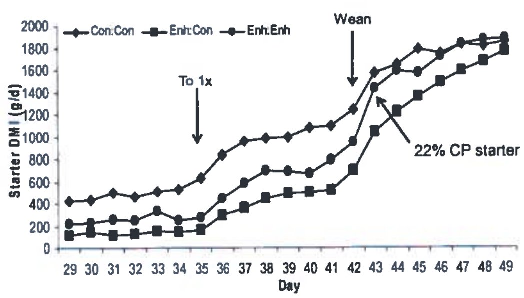
Average daily gain decreases, but calves still gain…



*Milk feeding rate x Week
†Starter CP% x Week

Stamey et al., 2005

Daily starter intake around weaning



Stamey et al., 2005

Heat stress and cold stress increase energy requirements of calves

Critical temperatures (CT): *Effective environmental temperatures where animals must expend energy to maintain body temperature*

Lower CT — Thermoneutral zone (energy use at minimum) — Upper CT

13 °C (< 21 days)
0 °C (> 21 days)

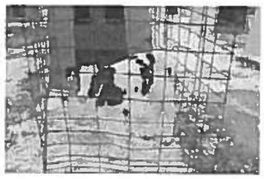
25 °C

Increased energy needed to stay warm

Increased energy needed to cool

Cold stress increases maintenance requirements

- Maintenance of 45-kg calf requires:
  - 0.73 kg of milk replacer powder at - 18°C vs 0.38 kg of powder at 16°C
  - Calf growth and health will be impaired if underfed



Impact of heat stress on calf maintenance requirements

- Increased maintenance requirements not well defined for calves <100 kg; 25% greater?
- For older heifers, multiply maintenance energy
  - by 1.07 if rapid shallow breathing
  - by 1.18 if open mouth panting
- Growth decreased by 1/3 at conventional feeding

Calves have limited body fat reserves to call on during nutritional stress

					P	
Variable	Base-line	CON: CON	ENH: CON	ENH: ENH	Starter CP %	Milk feeding rate
5-wk EBW[1], kg	40.6	55.1	65.4	63.6	0.74	0.14
EBW ADG, kg/d	—	0.24	0.60	0.59	0.86	0.01
5-wk Final fat, kg	1.59	2.65	3.28	3.27	0.98	0.13
Fat gain, kg	---	0.78	1.46	1.51	0.85	0.02
Final fat/ EBW, %	3.95	4.82	5.02	5.11	0.75	0.43

[1]EBW = Empty body weight

Stamey et al., 2005

Field data: Intensified feeding programs improve health of young calves

- Data from consulting veterinarian's practice
- Intensified feeding programs **decreased medical treatment costs by 30%** across several large calf-raising operations; especially beneficial for decreasing post-weaning respiratory disease

R. B. Corbett, Proc. Mid-South Conf., 2003

Summary so far...

- Tissue needs for energy and protein are same before and after weaning
- These requirements are *often not met* at weaning because of insufficient starter intake to maintain growth
- Cold stress aggravates this deficiency
- Calves have limited energy stores to call on in times of need

Meeting the nutrient requirements of calves around weaning

To avoid nutritional stress at weaning, we must strive for adequate starter intake

- Promote starter intake
- Water management!
- Don't wean too early
- Wean gradually
- Minimize hay intake

Increasing milk replacer intake delays starter intake

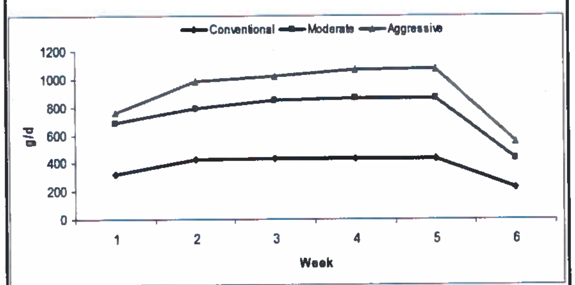
- Maximum total DM intake is 2.0 to 2.25% of BW
- High rates of milk or milk replacer substitute for starter intake

Example experiment: Comparing different milk replacer feeding rates

Milk Replacer Composition (DM basis)			
Component	Conventional	Moderate	Aggressive
Crude Protein, %	19.2	26.4	26.6
Crude Fat, %	19.2	18.8	20.2

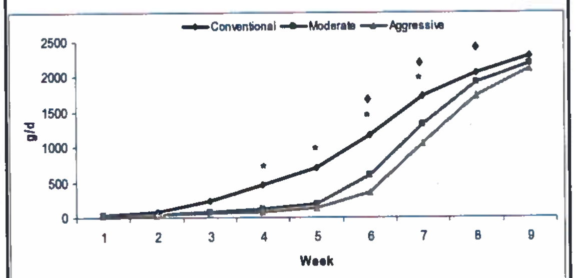
Stamey et al., 2006

Comparing different milk replacer feeding rates: Milk replacer intake



Stamey et al., 2006

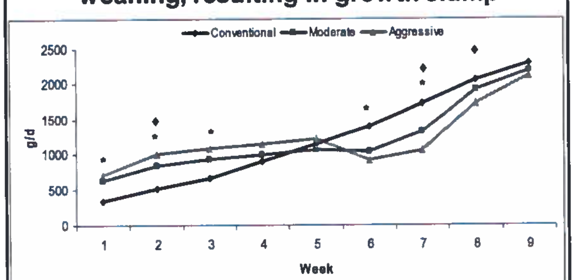
Comparing different milk replacer feeding rates: Starter intake



*Conventional v. Enhanced: $P < 0.05$
♦Moderate v. Aggressive: $P < 0.05$

Stamey et al., 2006

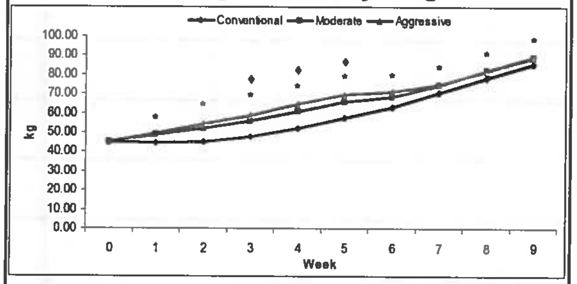
Total DM intake may decrease around weaning, resulting in growth slump



*Conventional v. Enhanced: $P < 0.05$
♦Moderate v. Aggressive: $P < 0.05$

Stamey et al., 2006

Comparing different milk replacer feeding rates: Body weight



*Conventional v. Enhanced: $P < 0.01$

♦Moderate v. Aggressive: $P = 0.13$

Stamey et al., 2006

Improve water management to promote starter intake

Importance of water for calves

- Inadequate free water leads to
  - –Decreased starter intake
  - –Insufficient water for tissue growth
  - –Stress response
- = ***Decreased growth***

TABLE 1. Performance and intake of calves fed water for ad libitum intake or no water.

	Water	
	Ad libitum	None
No. calves	20	21
Initial weight, kg	44.2	43.1
Weight gain, kg/4 wk	8.45[a]	5.26[b]
Wk 1	.23	.27
Wk 2	−.32	−.64
Wk 3	3.09	3.13
Wk 4	5.45	2.50
Calf starter intake, kg/4 wk	11.72[a]	8.08[b]
Wk 1	.23	.27
Wk 2	.95	.64
Wk 3	3.50	2.72
Wk 4	7.08	4.45
Water intake, kg/4 wk	41.33	
Wk 1	7.95	
Wk 2	6.99	
Wk 3	8.27	
Wk 4	18.12	
Increased withers height, cm	3.0	2.6
No. calves with scours	19	21
Average number scour days/calf	4.5	5.4

[a,b] Means with different superscripts within a row differ ($P<.05$).

Kertz et al., 1984

Empty-body composition of Holstein calves

	Diet		
Component	d1	5 wk	10 wk
Water, %	74.2	72.9	72.0
Protein, %	18.2	17.5	17.6
Fat, %	3.9	5.1	5.8
Ash, %	3.6	3.9	3.8

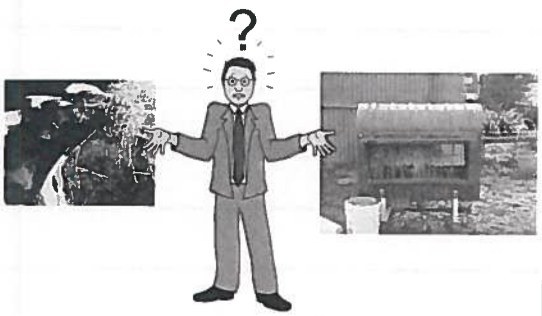
Calves at d 1 had received colostrum; calves at 5 wk were consuming both milk replacer and starter; calves at 10 wk were consuming only starter.

Stamey et al., 2005

Providing water to preweaned calves is too often limiting on farms

- Provide clean and freely available water in both warm and cool weather
- In cold weather provide warm water after milk feeding
- Water quality is important as in other cattle

Should we feed hay to calves?



What are we trying to develop?

- Size/volume of rumen (driven by *feed*)
- Musculature of rumen (driven by *bulk*) - movement of rumen - turning digestion
- Absorptive epithelium (*papillae*; driven by *VFA*)
- Microbial population (driven by *feeds;* produces VFA and depends on epithelium for acid absorption)

What are we trying to develop?

- Size/volume of rumen (driven by *feed*)
- Musculature of rumen (driven by *bulk*)
- **Absorptive epithelium** (*papillae*; driven by *VFA*)
- * **Microbial population** (driven by *feeds;* produces VFA and depends on epithelium for acid absorption)

Effects of diet on rumen development

- Milk and hay do little to develop rumen epithelium (papillae)
- Grain (starter) is key to development of rumen papillae via VFA production
- Rumen size does not differ markedly between calves fed grain or hay
- Papillae development can occur by 3-4 wk of age with good starter management
- Process takes ~3 wk no matter when start

Reticulum and rumen lining of 6-week-old calf fed milk and grain

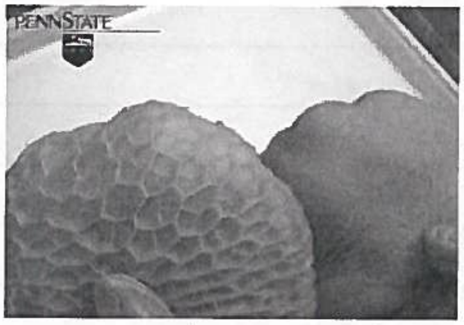
http://www.das.psu.edu/dairynutrition/calves/rumen/

Reticulum and rumen lining of 6-week-old calf fed milk only

http://www.das.psu.edu/dairynutrition/calves/rumen/

Penn State
Dairy and Animal Science
Calf Rumen images

Reticulum and rumen lining of 6-week-old calf fed milk and hay only



http://www.das.psu.edu/dairynutrition/calves/rumen/

Rumen pH in young rumen is very low, with or without hay in the diet

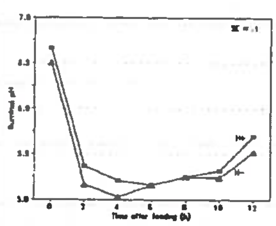
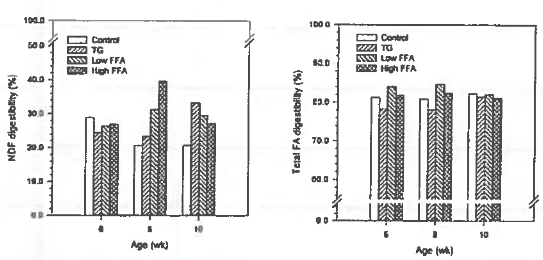


Figure 1. Ruminal pH with time after feeding in calves fed starter (4.5 kg/d) with (H+) or without (H–) alfalfa hay for ad libitum consumption.

Sustained rumen pH >6.0 is needed to establish cellulose-digesting bacteria

Quigley et al., 1992

Digestibility of NDF is very low in young calves



Starter contained 25% alfalfa meal and 8% wheat bran.
No forage fed.

Spanski et al., 1996

Peformance of calves fed varying amounts of grain and hay

Variable	Diet 1	2	3	4	5
Grain DMI, kg/d	0.40	0.76	1.04	1.34	1.37
Hay DMI, kg/d	0.63	0.34	0.26	0.23	0.06
GIT contents, kg	13.8	12.8	12.8	11.9	11.3
ADG, kg/d	0.32	0.42	0.47	0.60	0.59
EBG, kg/d	0.14	0.24	0.31	0.43	0.43
% of ADG due to gut & fill	73.4	55.5	48.7	37.9	38.6

Calves were fed 3.0 kg/d milk from 0 to 5 wk.

Stobo et al., 1966

Postweaning performance of calves fed starter without or with chopped hay

Trial and variable	Diet C	G	H1	H2
Trial 1				
ADG, kg/d	0.91	0.74	1.22	1.02
Gain:Feed	0.52	0.42	0.66	0.58
Trial 2				
ADG, kg/d	0.78	0.72	0.85	0.82
Gain:Feed	0.50	0.50	0.51	0.57

C = course starter, G = ground starter, H1 = C + 7.5% chopped hay, H2 = C + 7.5% chopped hay.
Bromegrass hay seived to 8 to 19 mm length

Coverdale et al., 2004

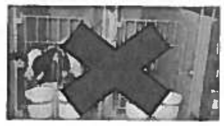
Summary: Hay or not?

- Hay is poorly digested and decreases intake of starter, which is most important for rumen development
- Hay is not necessary for development of rumen volume and rumination
- Up to 15% chopped hay can be included in starter if calves not bedded on straw or to prevent bloating
- Free choice hay should not be provided until >2 wk postweaning

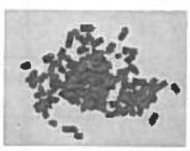
heifers

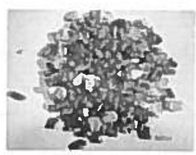
Starter management

- Keep fresh (ideally replace daily)
- Separate feed container from water container
  - By location, or
  - By divider

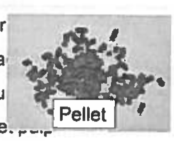


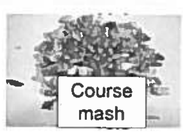
Physical form of starters





Composition of starters fed as pellet or textured





Ingredients, %	Low fiber	High fiber
Cor	—	
Cra	33.8	
Cru	35.0	
Bee	---	
Brewers grains	---	10.0
Soybean meal (50%)	20.7	18.0
Molasses	7.0	7.0

Plus minerals and vitamins to similar composition.
No forage fed, no bedding, ad lib water.

Porter et al., 2007

Growth and development of calves fed high or low fiber starters as pellet or textured

Variable	Fiber		Form	
	Low	High	Pellet	Mash
n	15	17	16	16
ADG, kg/d	0.34	0.39	0.32^{a}	0.41^{b}
Starter intake, kg	50.4	58.2	47.7^{a}	60.9^{b}
Week first ruminating	5.1	4.6	6.0^{a}	3.7^{b}
% time ruminating	15.0	14.8	8.7^{a}	21.0^{b}
NDF digestibility, %	46.1	45.4	39.7^{a}	51.9^{b}

Calves fed milk replacer (26/19) at 0.45 kg/d, weaned at 4 wk

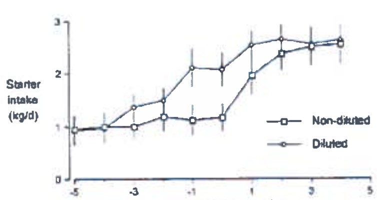
^{a,b} $P < 0.05$

Porter et al., 2007

?

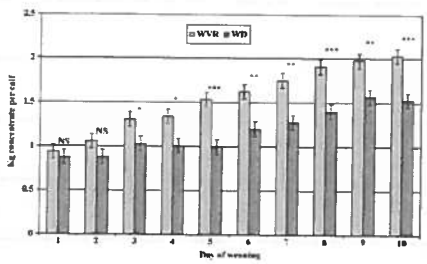
How to wean?

Gradually decreased milk solids consumed by diluting milk with water increases starter intake more rapidly

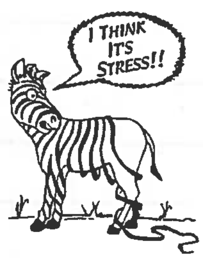


Jasper et al., 2008

Gradual weaning by volume reduction increases starter intake more than weaning by milk dilution



Nielsen et al., 2008

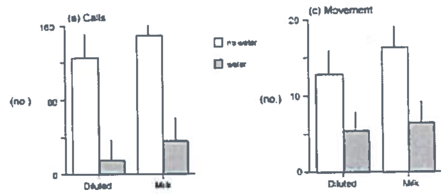


Non-nutritional distress of weaning

Avoid additional stressors around weaning: remember the "transition period"

- Do not move or group calves for 2 wk after weaning
- Do not vaccinate, dehorn, or give other medical treatments at weaning
- Consider offering warm water after weaning to separate milk withdrawal from behavioral aspects

Weaning induces behavioral stress, but providing warm water at normal feeding times after weaning lessens stress



Jasper et al., 2008

Weaning can compromise immune system function: increased susceptibility to disease

- Studied effects of *weaning age* (5, 9, 13 wk) for calves fed 0.4 kg/d milk replacer plus starter and hay), and effects of *nutrient intake* (0.4 kg/d milk replacer or 1.0 kg milk replacer; plus starter and hay) in calves weaned at 9 wk of age

Pollock et al., 1993, 1994

Weaning and the immune system (2)

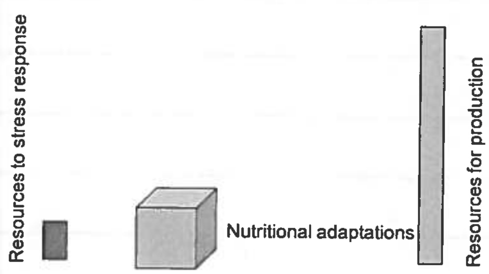
- Weaning at 5 wk caused increased skin response to antigen, decreased lymphocyte responses, and decreased specific IgG response to antigen at 9 wk
- Calves fed higher milk replacer had:
  - improved cell-mediated immunity
  - decreased skin response to antigen
  - decreased antibody titer to specific antigens
  - More protein and IgG_2 in lung secretions

Pollock et al., 1993, 1994

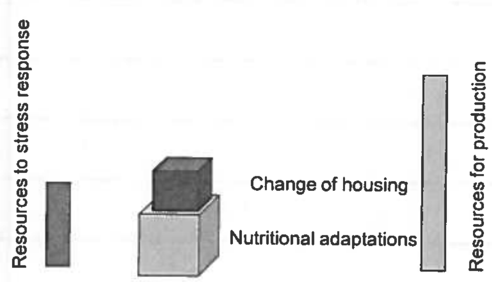
Effects of multiple stressors are additive

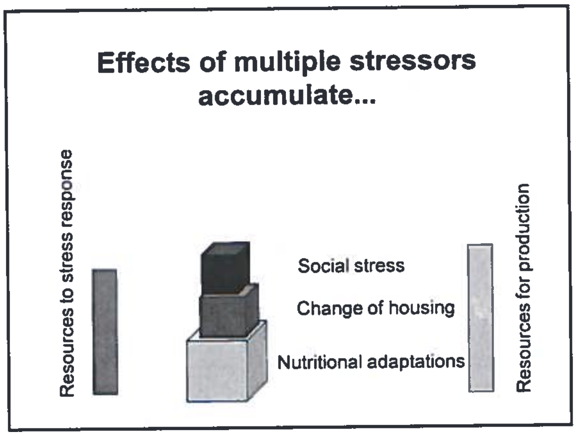
- Single stressor alone may not impact calves, but effects of multiple stressors may sum to have significant negative impacts
- May compromise well-being, decrease performance, or cause sickness

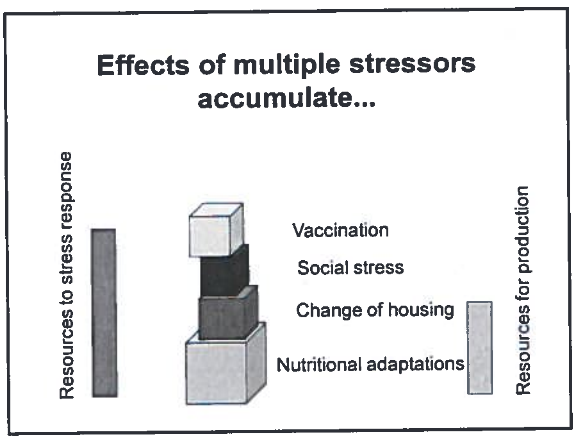
Multiple stressors - the "tower of building blocks" analogy

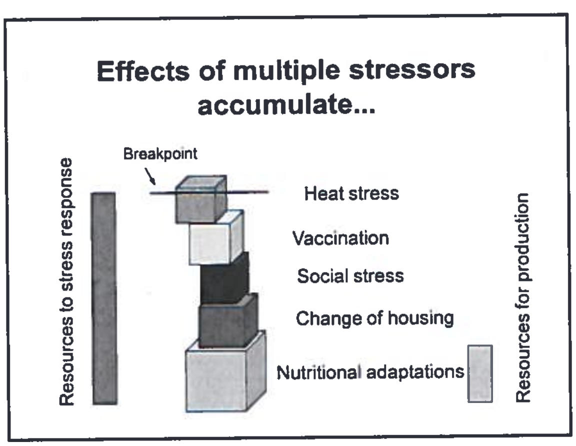


Effects of multiple stressors accumulate...



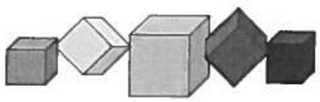

Effects of multiple stressors accumulate...
Resources to stress response
Social stress
Change of housing
Nutritional adaptations
Resources for production


Effects of multiple stressors accumulate...
Resources to stress response
Vaccination
Social stress
Change of housing
Nutritional adaptations
Resources for production


Effects of multiple stressors accumulate...
Breakpoint
Resources to stress response
Heat stress
Vaccination
Social stress
Change of housing
Nutritional adaptations
Resources for production

... until a breakpoint is reached and the system fails

Disease and growth check



The ideal weaning...?

- Wean when calves consume >1.5 kg starter daily
- Wean gradually over 4 to 7 d by decreasing volume of milk
- Offer warm water at normal feeding time for 3 d after weaning
- Do not move calves for 2 wk postweaning
- Do not combine weaning with other management tasks such as vaccination, dehorning, etc.
- Ensure adequate intake of coccidiostat before and after weaning

Thank you

drackley@illinois.edu

Mycoplasma bovis: Take control!

Anyone who raises calves at one time or another has experienced an outbreak of *Mycoplasma bovis (M.bovis)* in their barn. *M. bovis* is a frustrating disease that affects calves at any age. What makes it more frustrating is that it is hard to detect and treat- it is not viral and yet not bacterial either. Dr. David Francoz has spent the last few years researching *M. bovis* in depth and is a leading expert on the disease. Dr. Francoz will give us an overview of the disease, how we can manage our way out of an outbreak, and what we can do to prevent an outbreak on farm. Dr. Francoz will give us take home advice on how to take control of the disease and get your barn back under control again.

Dr. David Francoz

Dr. David Francoz graduated from the École Nationale Vétérinaire de Nantes, France. He has completed a residency program in food animal medicine and surgery as well as a Masters in clinical sciences at the Faculté de médecine vétérinaire at the Université de Montréal, Saint-Hyacinthe. He has also received a diploma from the American College of Veterinary Internal Medicine. Currently Dr. Francoz is an associate professor in food animal medicine at the Faculté de médecine vétérinaire at the Université de Montréal. His research interests are in infectious diseases, mainly mycoplasma associated diseases and septic arthritis.

Funding for this presentation was provided in part by Agriculture and Agri-Food Canada through the Agricultural Adaptation Council's CanAdvance Program.

BUILDING THE FOUNDATION

Dairy and Veal Healthy Calf Conference **2008**

CHUV
Université de Montréal

Mycoplasma bovis : take control!

David Francoz, DMV, MSc, ACVIM

Mycoplasma, what's that?

- One of the smallest bacteria
- Difficult to isolate and cultivate
  - Specific media
  - Culture is long
- In cattle more than 30 different species
  - But one is more pathogenic in North America
    - *Mycoplasma bovis*

M. bovis: the coming back of an old bacterium…

- First isolation from mastitis cases in 1961
- First isolation from pneumonic cases in 70s

M. bovis: the coming back of an old bacterium

- Feedlot:
  - Most frequent infectious agents isolated in cases of pneumonia
  - Chronic pneumonia and polyarthritis syndrome
  - Decreased weight gain/carcass value: $32 million per year

M. bovis: the coming back of an old bacterium

- Dairy cows
  - Increasing cases of *M. bovis* mastitis
    - *M. bovis* mastitis: $108 million per year
  - Few data in Canada:
    - Prince Edward Island: 2% of the herds
    - Outbreaks reported in Québec

Outbreak of *M. bovis* infection in a dairy herd

- A dairy herd: 35 cows in milk, 70 animals
- 4 dairy cows were newly introduced
- 2 weeks later… development of pneumonia
  - First in 4 dairy cows
  - Then all the cows in milk
  - 4 days later 54 animals including calves and heifers
  - Development of mastitis in the dairy cows
- No response to the treatments instituted

Outbreak of *M. bovis* infection in a dairy herd

- 4 dairy cows died; 2 were necropsied
  - Results: *Mannheimia haemolytica* and *Mycoplasma bovis* pneumonia
- Milk samples: *Mycoplasma bovis*
- Antibody detection: 2 blood samples
  - Great increase in *Mycoplasma bovis* antibodies
  - Except for the 4 newly introduced cows that already had high levels of antibodies

Outbreak of *M. bovis* infection in a dairy herd

- Diagnosis: *Mannheimia haemolytica* and *Mycoplasma bovis* pneumonia, and *M. bovis* mastitis outbreak
- Few weeks later:
  - 22 cows and 2 heifers died
  - 7 cows were culled

M. bovis: the coming back of an old bacterium

- Dairy calves
  - One of the most important infectious agent:
    - Pneumonia
    - Otitis media
    - Septic arthritis

How do dairy calves get infected?

- Even if *M. bovis* is an old bacterium only few new data are available on transmission and contamination of animals
- *M. bovis* can be found on healthy animals

... and probably in most of dairy herds...

How do dairy calves get infected?

- Ingestion of contaminated milk
  - Role of colostrum?
- Inhalation of infected nasal secretions
  - Nose to nose contact
- Inhalation of infected vaginal secretions
  - Calving time
- *In utero* infection
- Contaminated environment

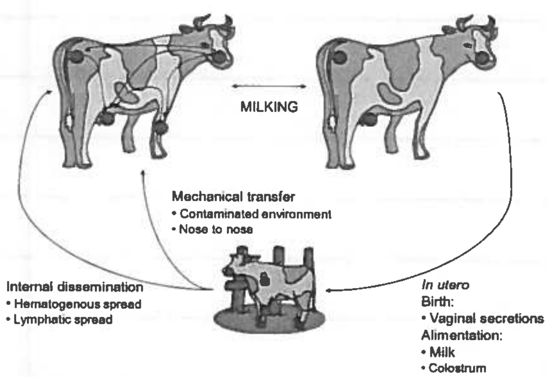
What happens to infected calves?

- Development of clinical signs
  - Inoculum
  - Viral infection: role of BVD
  - Stress
  - Environmental factors
    - Humidity
    - Density
    - ...

What happens to infected calves?

- Carrier state
  - Duration?
    - Experimentally infected calves carry *M. bovis* up to 12 months of age
  - Environmental contamination
  - Nose to nose contamination
  - Internal transmission
    - Mastitis, udder contamination?

Vicious circle of contamination



Clinical signs - pneumonia

- Typical signs of pneumonia in dairy heifers
  - Tachypnea
  - Dyspnea
  - Fever
  - Nasal/ocular discharge
  - Cough
  - Loss of appetite
- Other concurrent diseases: otitis, septic arthritis

Lesions – pneumonia

- Typical necrotizing lesions
  - 2-4 mm necrotic areas with yellow to yellow white materials ⇨ palpable or visible nodules
  - Linear yellow necrotic lesions

Lesions – pneumonia

- Severe advanced cases
  - Large irregular
  - Firm necrotic lung
  - Fibrinous or fibrosing pleuritis

Clinical signs – otitis media

- Non specific clinical signs: fever, anorexia
- Nerve lesions
  - Ptosis
  - Ear drop
  - Lip drop
  - Epiphora exposure keratitis

Clinical signs – otitis media

- Nerve lesions
  - Head tilt
  - Abnormal locomotion
- Ear discharge
- Concurrent diseases
  - Pneumonia, septic arthritis

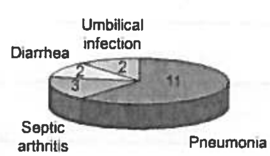
A retrospective study of 15 cases in our clinics

- 14 Holstein, 1 Ayrshire
- 2 to 18 weeks
- 8/9 fed whole milk

A retrospective study of 15 cases in our clinics

Season of hospitalisation

Concurrent diseases



A retrospective study of 15 cases in our clinics

- Ear discharge bacterial culture
  - Routine culture: 7/8 negative
  - Mycoplasma culture: 6/6 positive
    - 4 cases: *M. bovis* pure culture
    - 1 case: *M. bovis* and *P. multocida*
    - 1 case: *Mycoplasma* spp. pure culture

Lesions – otitis media

- Erythema and thickening of the mucosa of the auditory system
- Purulent material in the tympanic cavity
- Destruction - sclerosis of the bony structure

Clinical signs – septic arthritis

- Typical signs of septic arthritis
  - Fever, loss of appetite
  - Lameness
  - Painful and swollen joint
- Periarticular soft tissue may be affected
  - Clinical signs of tenosynovitis

Clinical signs – septic arthritis

- Affected joint
  - Stifle, tarsus and carpus
- More than one joint may be affected
- Concurrent diseases
  - Pneumonia
  - Otitis media

Lesions – septic arthritis

- Abundant yellow fibrinous or slimy thick exudate is present
- In advanced cases
  - Cartilage may be completely destroyed
  - Severe osteomyelitis may be present
- Necrosis of periarticular soft tissues
  - Tendon, muscles

Clinical signs – other diseases

- Endocarditis
- Meningitis
- Decubital abscesses
- Pinkeye

How to suspect a *M. bovis* infection?

- No specific clinical signs but...
- Chronic and weakening diseases
- No response to common antibiotic treatments

How to confirm a clinical case of *M. bovis* infection?

- Culture or detection of *M. bovis*
  - Bacterial culture
  - PCR
  - Necropsy: Immunohistochemistry
- Antibody detection: serology
  - Not useful for individual cases

How to confirm *M. bovis* infection?

- Samples to send
  - Depends on the disease
    - Transtracheal wash
    - Nasal swab
    - Ear discharge
    - Synovial fluid
- How and where?
  - As soon as possible
  - Less than 24h: refrigerated
  - Specialized laboratories

Diagnosis of *M. bovis* as a herd problem

- Nasal swabs in 6 untreated calves
  - Culture positive for *M. bovis* ≥ 2/6 calves
  - *M. bovis* is to be considered as the major infectious agent in dairy calves pneumonia/otitis media and β–lactam antibiotics (penicillin, ampicillin, ceftiofur) are not included in antibiotic protocol

Diagnosis of *M. bovis* as a herd problem

- Serology – M. bovis antibodies detection
  - Commercially available only in Québec
  - Interpretation
    - Only few data available
    - 2/3 of calves probably have *M. bovis* Ab

Treatments

- Since *M. bovis* is a bacterium, the treatment of *M. bovis* infections require antibiotics!
- Determination of *M. bovis* antimicrobial susceptibilities difficult
- Penicillin and ceftiofur are not effective

Treatments

- Antibiotics reported to be effective include:
  - Macrolides
    - Tylosin
    - Tilmicosin
    - Taluthromycin
  - Tetracycline
  - Aminocyclitol
    - Spectinomycin
  - Florfenicol
  - Fluoroquinolones
    - Enrofloxacin
    - Danofloxacin
  - Tiamulin
  - Lincosamide
    - Lincomycin

Treatments

- Increased resistance reported against different antibiotics
  - Tilmicosin (Micotil)
  - Tetracyclines
  - Spectinomycin (Spectam)
  - Lincomycin

Increased antibiotic resistance

- In our clinics: 58 isolates of *M. bovis*

	spectinomycin	tetracycline	clindamycin (lincomycin)	enrofloxacin
sensitive	63 %	39 %	76 %	93 %
resistant	37 %	61 %	24 %	7 %

Treatments

- None of the antibiotics commercially available are homologated for the treatment of mycoplama infections in dairy heifers
- Duration of treatment?
  - Chronic and recurrent infections
  - Long term: 10 to 15 days?

Prognosis

- Few studies are available
  - Pneumonia?
  - Otitis media:
    - In our clinic: 60% with long term (15 days) antibiotic treatment
  - Septic arthritis:
    - In our clinic: long term prognosis 25%
- Probably depends on early diagnosis and concurrent diseases

Prevention - control

- Prevention of *M. bovis* diseases is limited
  - No complete understanding of the epidemiology of *M. bovis* diseases in heifers
  - *M. bovis* is everywhere!
- Based on:
  - Decreased infection pressure
  - Decreased potential risk factors
  - Development of a specific immunity
  - Prevent introduction

Decreased infection pressure

- Milk and colostrum
  - If calves are fed with whole milk check for mycoplasma mastitis in cows
  - Avoid whole milk
    - On farm pasteurisation of whole milk
    - Milk replacer
  - Colostrum?

Decreased infection pressure

- Avoid overcrowding
- Limit nose to nose contact
- Segregation of ill animals
- Adequate ventilation
- Clean environment and materials
  - *M. bovis* can be eliminated using conventional disinfectants (iodophor, peracetic acid)

Decreased infection pressure

- Prevention of the introduction within the herd:
  - Purchase procedures
    - History of the originating herd
    - Seronegative animals
      - Possible?
    - Milk samples in cows
    - Nasal swabs to identify carriers

Decreased potential risk factors

- Decrease the risk of concurrent diseases
  - Adequate passive transfer of immunity
  - Control and prevention of BVD virus
  - Adequate vaccination program
- Provide proper management practice
  - Alimentation
  - Ventilation
  - Sanitation...

Specific immunity

- Difficult
- No commercial vaccines approved for dairy calves
- Results of vaccination of young dairy calves are contradictory
- Passive transfer of *M. bovis* specific Ab does not appear to confer protection

Conclusion

- *M. bovis* diseases are emerging in dairy calves
- Antimicrobial resistance is of major concern
- Prognosis is guarded
- Studies are required for a better understanding of the epidemiology of *M. bovis* and the institution of adequate preventive measures

Managing Group Housing for Calves

More producers are now rearing calves in groups, but can group housing work for you? Dr. Dan Weary and colleagues at the University of British Columbia form one of the world's top research groups working on calf care. Dr. Weary will share recent research findings that provide a scientific basis for recommendations for how to feed and manage milk-fed calves housed in groups.

Dr. Dan Weary

Dan Weary (B.Sc., M.Sc., D. Phil.) is a Professor and NSERC Industrial Research Chair at The University of British Columbia. Dan is recognized internationally for his research on improved care and management of dairy cows and calves. He has authored over 100 scientific journal publications, and is a frequent speaker for dairy audiences.

Funding for this presentation was provided in part by Agriculture and Agri-Food Canada through the Agricultural Adaptation Council's CanAdvance Program.

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Dairy and Veal Healthy Calf Conference **2008**

animal welfare program

Group housing calves: problems and solutions

Dairy and Veal Healthy Calf Conference: London, Dec. 4th, 2008

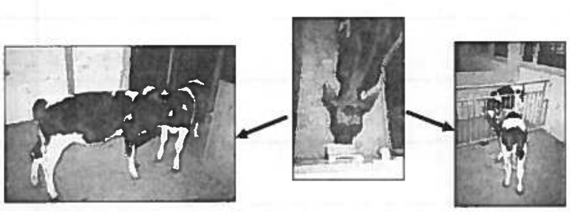
Group housing

Pros:
- Calves like it
- Social skills
- ***Labour***

Cons:
- Cross-sucking
- Competition
- Disease

Group housing

Calves are motivated to contact other calves - they work harder to obtain full contact than just head-to-head contact



Holm et al. 2002

Group housing

Group housing during the milk feeding period

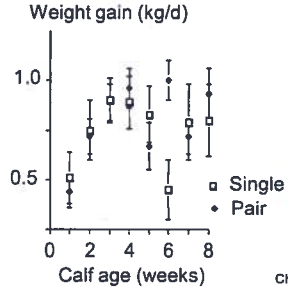
↓ Fear of conspecifics and novelty

↑ Social activity

Boe and Færevik, 2003

Group housing

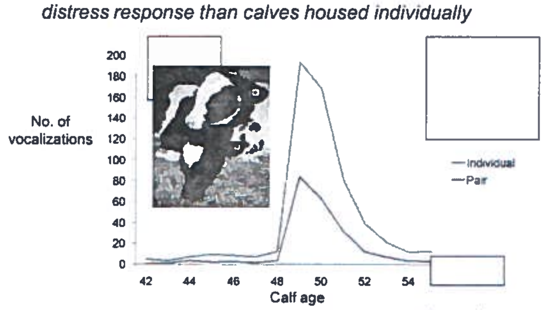
Paired calves do better at weaning - they experience less of a growth check than calves housed individually



Chua & Weary, 2002

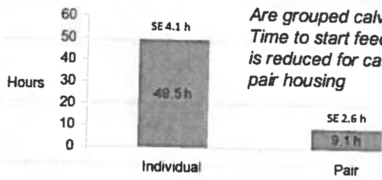
Group housing

Paired calves do better at weaning - they show less of a distress response than calves housed individually



De Paula Vieira et al.,in prep

Group housing



Are grouped calves smarter? Time to start feeding after mixing is reduced for calves that were pair housing

De Paula Vieira et al., in prep

What does the cow do?

- *Nurses calf 5 - 10 times/d*
- *Nursing bouts last 5 - 10 min*
- *Provides about 10 kg of milk/d*

What do we do?

- *Feed 2 times a day*
- *Provide about 4 kg of milk*

How to provide milk?

When provided free access to a teat, calves spent on average 47 min drinking milk, and spread this feeding time into 6 milk meals per day

Appleby et al., 2001

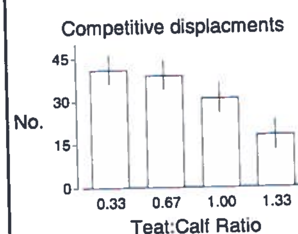
Cross-sucking

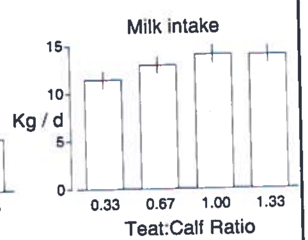
Well managed teat-feeding systems reduce cross sucking to very low levels

Jensen & Budde, 2006

Competition

Competition is reduced in smaller groups with more feeding stations





von Keyserlingk et al., 2004

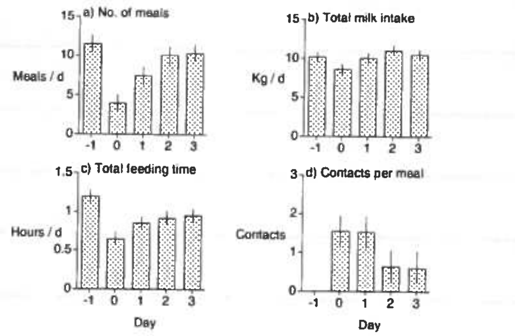
Competition

Competition is reduced by adding a barrier between feeding stations

No barrier **Short barrier** **Long barrier**

Jensen et al., 2007

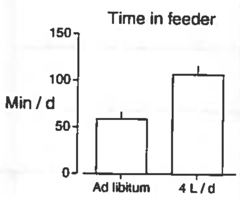
Mixing increases competition - use static groups and all-in-all-out management

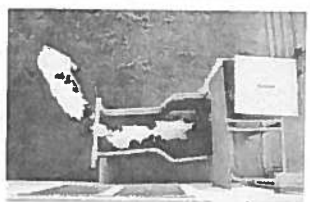


O'Driscoll et al., 2004

Competition

Competition is reduced by providing more milk (and fewer meals)

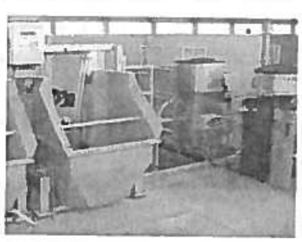




Vieira et al., 2008

Automated feeders

Our perspective?



Automated feeders

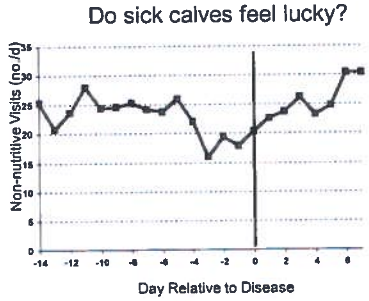
The calf's perspective?

Automated feeders

The calf's perspective?

Automated feeders

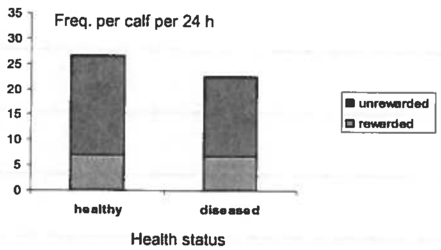
Do sick calves feel lucky?



Borderas et al., in prep

Automated feeders

Sick calves visit the feeder less often, but still consume as much milk



Svensson & Jensen, 2007

Calf health

Smaller groups have less risk of disease

Calves in groups of 6-9 vs. 12-18:

- 40% lower incidence of respiratory disease
- 40g/d higher daily gain

Svensson and Liberg, 2006

Calf health

Stable groups have less risk of disease

	Stable	Dynamic
Diarrhoea (% calves)	18	46
Respiratory (% calves)	20	44
Daily gain (g/day)	870	810

Pedersen et al., 2008

Calf health

Delay mixing if using dynamic groups

Introduced at day 6 compared to day 14
- more restless the first day after introduction *(Rasmussen et al., 2006)*
- needed more guidance to the feeder during the first week *(Jensen, 2008)*

Introduction delayed by one week
⇒ 50% lower risk of respiratory disease
Svensson and Liberg, 2006

Housing options

Take home messages:

- *Calves prefer grouping -- it allows for social contact and shared space, and calves benefit from improved social learning and reduced fearfulness*
- *Using a well-designed teat-feeding system minimizes cross-sucking*
- *Increasing the number feeding stations, using barrier between stations and increasing milk rations reduces competition*
- *Small, stable groups, and all-in-all-out management reduce the risk of disease*

Thanks!

NSERC, DFC, BC Dairy Foundation, Westgen, BC Milk Producers, BC Dairy Education and Research Association, etc.

CSI-Guelph: Lessons to be Learned from post mortem investigations

Quoted as being the "Gil Grisom of CSI-Guelph", Dr. Maria Spinato is a pathologist at the University of Guelph who is keenly interested in determining the cause and effect relationships that impact calf mortality. Sometimes it seems there is more going on with a calf's health than meets the eye and often identifying the problem in one calf can lead to a solution for the whole herd. Dr. Spinato will walk us through several different calf post mortem investigations while explaining what she is looking for with common disease problems such as pneumonia, enteritis and navel infections. Dr. Spinato will explain why it is useful to do post mortems on farm and when it is beneficial to go on with more elaborate testing. This type of information is very helpful in disease outbreaks on farm and for the overall health and benefit of the industry.

Dr. Maria Spinato

Dr. Spinato graduated from the Ontario Veterinary College in 1985, earned a DVSc in anatomic pathology in 1989, was board certified by the American College of Veterinary Pathologists as an anatomic pathologist in 1990, and earned an MBA from the University of Regina in 2004. She was most recently manager/ pathologist at the Animal Health Centre in Abbotsford, British Columbia, and was previously a pathologist and then manager at the Regina Laboratory of Prairie Diagnostic Services (formerly Saskatchewan Agriculture and Food) from 1989-2005. She has a special interest in bovine pathology and has spent many hours investigating the causes of abortion and neonatal calf losses.

CSI Guelph: Why did this calf die?

Healthy Calf Conference

London, ON

December 4th, 2008

Maria Spinato, *DVM DVSc MBA*

UNIVERSITY of GUELPH
LABORATORY SERVICES
Animal Health Laboratory

Roadmap:

- Overview of the Animal Health Laboratory
- Terms and definitions
- Photos of common calf diseases
- Necropsy case example: diarrhea outbreak
  - preparation
  - necropsy procedure
  - sampling and ancillary testing
  - reporting
- Partnerships in disease investigations

Objectives of OMAFRA for the AHL

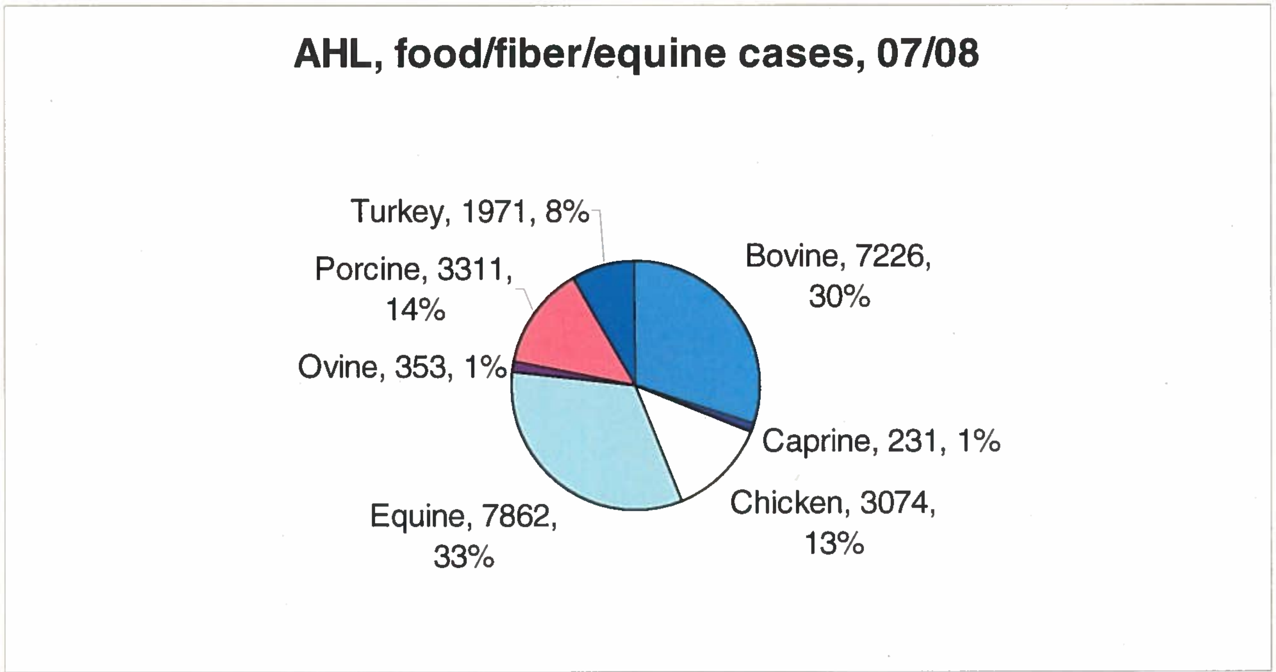
- support veterinarians and livestock organizations
- contribute scientific and diagnostic expertise to support business decisions
- help in the development of government policies and programs to mitigate threats to animal health

Services provided by the AHL

- anatomic pathology – Guelph and Kemptville
- bacteriology
- clinical pathology
- immunology/serology
- avian and mammalian virology
- molecular biology
- mycoplasmology
- parasitology
- toxicology/soil & nutrient
- surveillance

AAVLD-accredited + ISO 9001 + ISO 17025 registered

AHL caseload, fiscal 07/08



Facilities - Going from this ….

To this: New Pathobiology-AHL building 2010

Terms and definitions

- Pathology = study of disease
- Necropsy = post mortem examination
  - dissection to determine cause of death or nature of disease process
- Lesion = structural abnormality in a tissue
  - e.g. inflammation, hemorrhage, cancer
  - gross lesion = visible to the naked eye
  - histologic lesion = visible by microscopic exam

Terms and definitions

- Fibrinous Inflammation = type of inflammation often caused by bacterial infections
  - characterized by damage to blood vessels and formation of thick, white, stringy exudate

- Septicemia = systemic disease caused by presence of bacteria or bacterial toxins in the bloodstream

Necropsy – Why?

- Determine cause of death
- Identify disease-causing agent
- Assist in selection of appropriate treatment
- Guide management prevention strategies
- Monitor disease trends in the population

Necropsy – Where?

- On Farm:
  - single dead animal
  - cursory examination sufficient
  - requires basic understanding of anatomy and disease processes
- At a Veterinary Diagnostic Laboratory:
  - several dead animals or disease outbreak
  - complete examination needed
  - diagnosis requires microscopic exam of tissues

Necropsy – When?

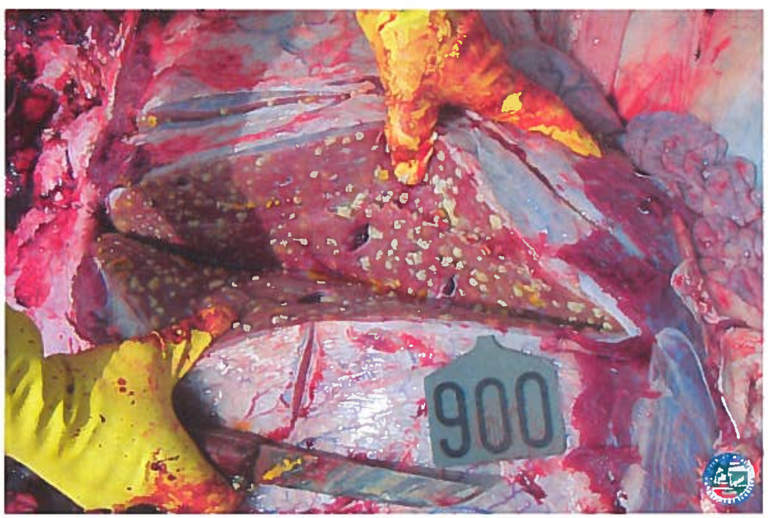
- As soon as possible after death!
  - tissue decomposition adversely affects:
    - i) microscopic evaluation
    - ii) isolation of bacteria, viruses and parasites
- To maximize value of necropsy:
  - conduct necropsy on site
  - keep body cool (4°C) and transport to lab asap
  - sacrifice sick or moribund animal if necessary

    e.g. outbreak of diarrhea

Problem-Oriented vs. Complete Necropsy

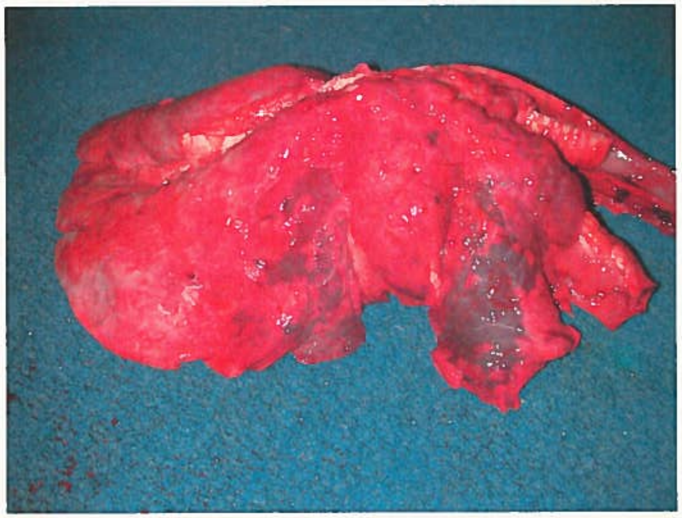
- Problem-oriented necropsy concentrates on one tissue or organ system:
  - to confirm tentative diagnosis
  - to collect samples for identification of infectious agent
  - to determine cause of treatment failure
  - e.g. abomasal ulcer, pneumonia
- Systematic or complete necropsy performed when:
  - unexpected death with no signs of illness
  - vague illness that cannot be identified
  - animals do not respond satisfactorily to treatment
  - multiple animals and/or systems affected
  - e.g. septicemia, diarrhea, pneumonia

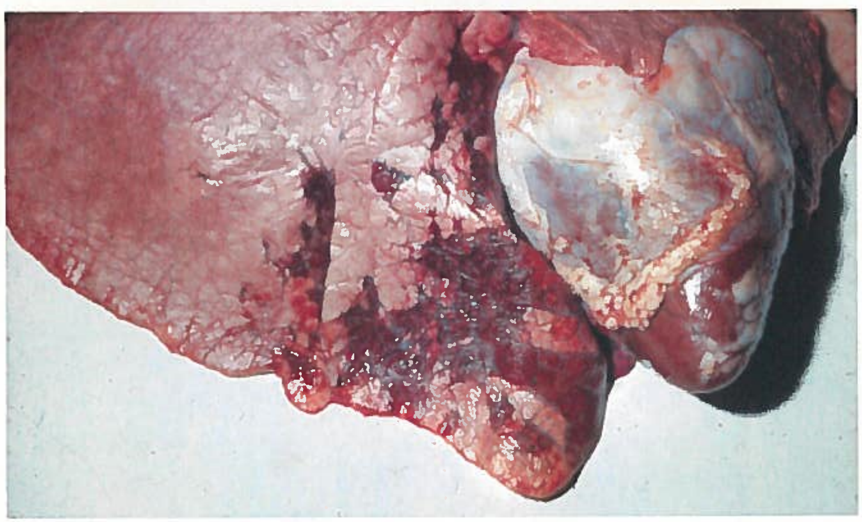
Navel Ill - Omphalophlebitis



- associated with failure of passive transfer
- may cause death due to secondary lesions: septicemia, liver abscesses
- indicator of decreased immunity predisposing calf to other diseases

Calf Pneumonia





- "enzootic" most often refers to Mycoplasma sp.
- may be mild with only a small portion of cranial (anterior) lung affected

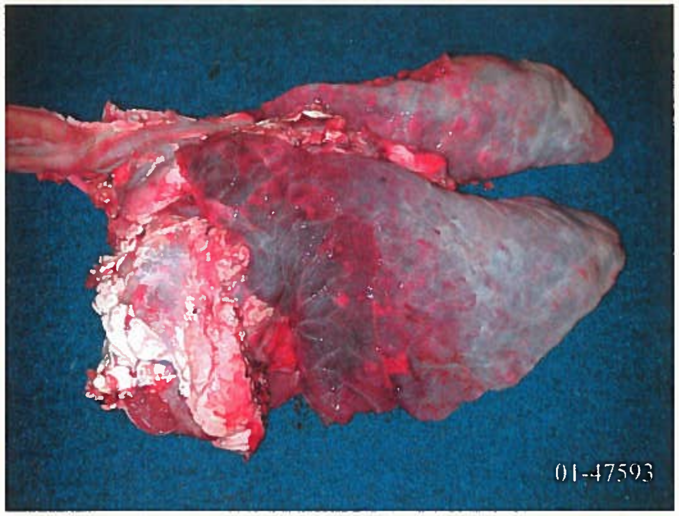
or....

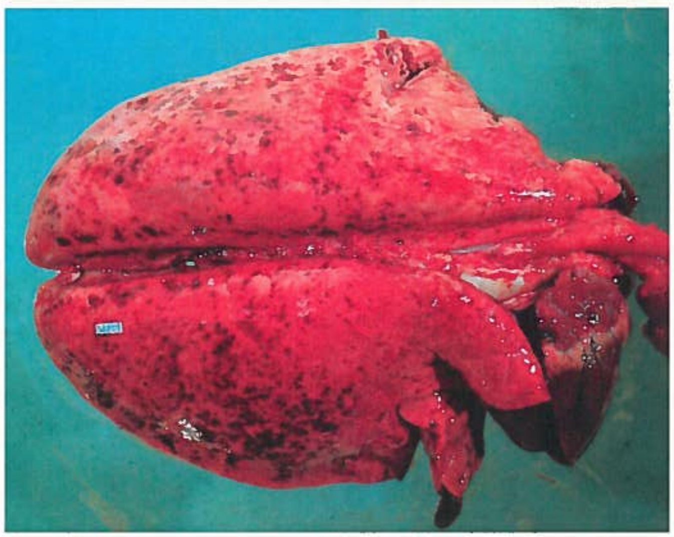
Calf Pneumonia

.....Mycoplasma can also cause severe pleuropneumonia that is difficult to differentiate from:

Histophilus somni pleuropneumonia

Calf Pneumonia





- BRSV: entire lung often evenly affected - red and firm

- bacterial septicemia: entire lung often red and wet +/- small hemorrhages

Calf Pneumonia

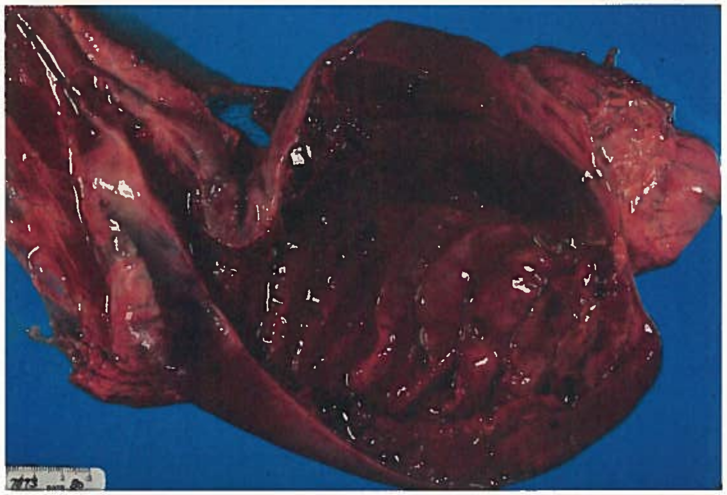
Bacterial Pneumonia:

- affects front half of lung
- gross lesions usually more severe, may include fibrin and pus
- culture required to identify organism and select appropriate antibiotic treatment

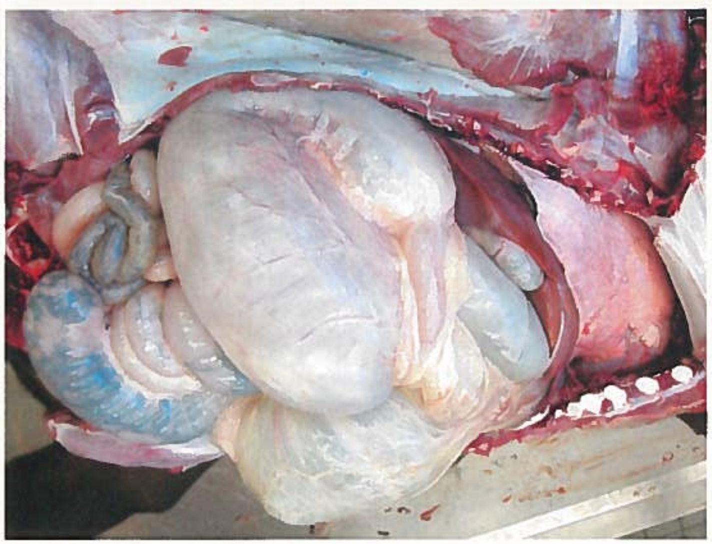
Viral Pneumonia:

- often affects entire lung
- difficult to differentiate from lung inflammation caused by bacterial septicemia
- microscopic examination, virology testing required to confirm

Calf Gastroenteritis – Abomasal Disorders

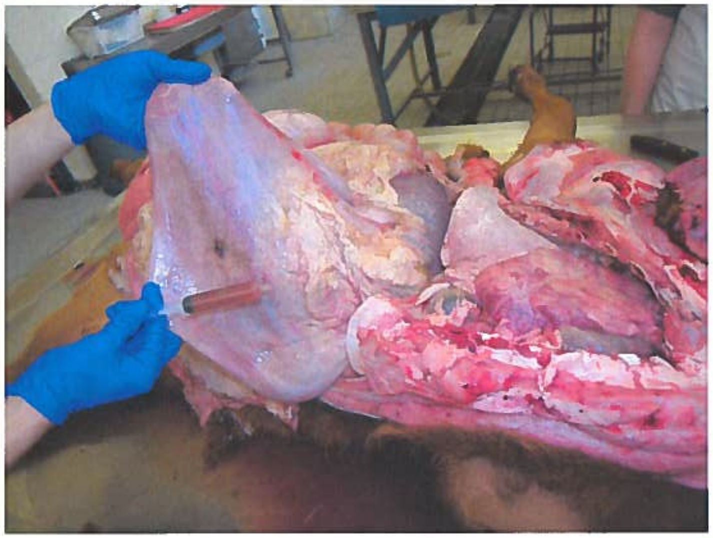


Braxy = clostridial abomasitis

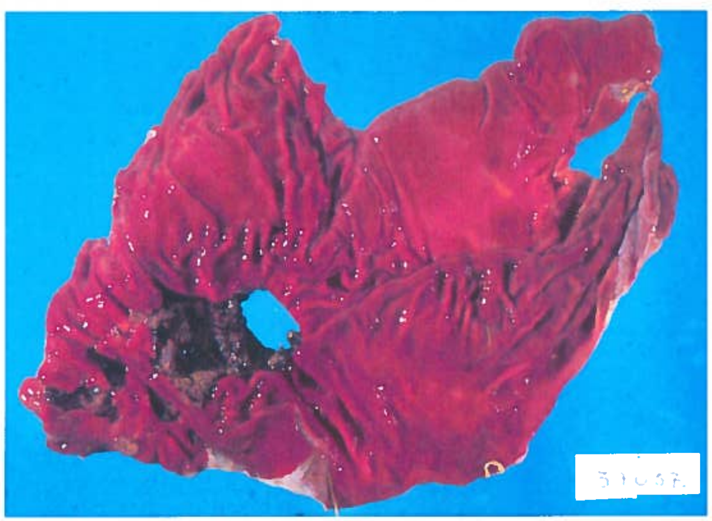


Abomasal torsion

Calf Gastroenteritis – Abomasal Disorders



Peritonitis caused by perforating abomasal ulcer



Abomasal lesions often affect individual calves

Calf Gastroenteritis – Intestinal Disorders

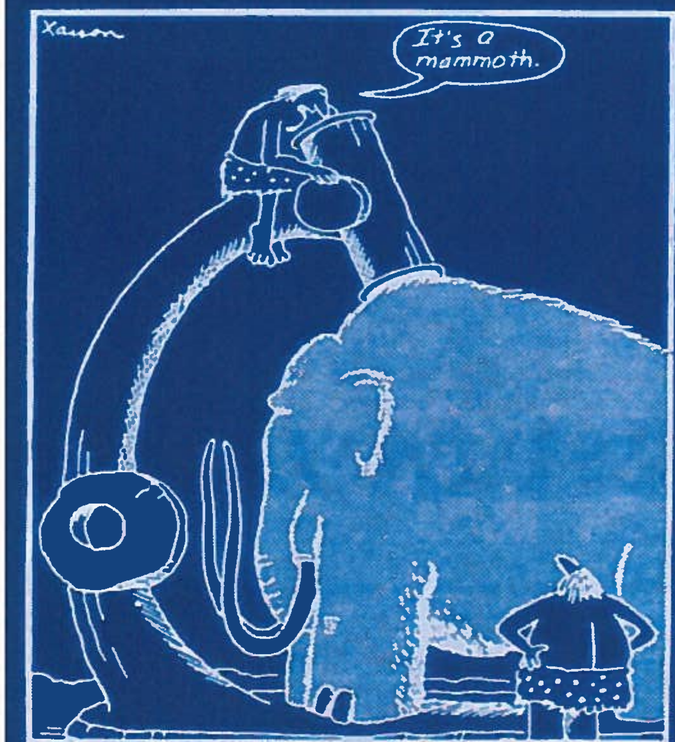
- Dark red intestines = enterotoxemia due to *Clostridium perfringens*
- Could resemble "twisted gut" = mesenteric torsion

…but what about this?

Calf Gastroenteritis - Diarrhea

- Many causes of calf diarrhea produce only mild gross lesions in intestines: fluid, gas +/- mild congestion, including:
  - Enterotoxigenic E. coli
  - Bovine rotavirus
  - Bovine coronavirus
  - Cryptosporidium
  - Nutritional
- More severe inflammation, including hemorrhage and fibrin, may be seen with:
  - Salmonella
  - Clostridium perfringens enterotoxemia

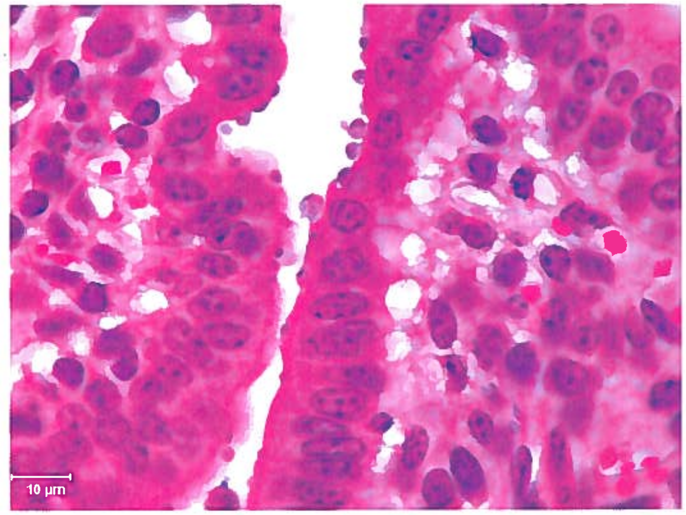
Calf Gastroenteritis – Diarrhea



Early microscope

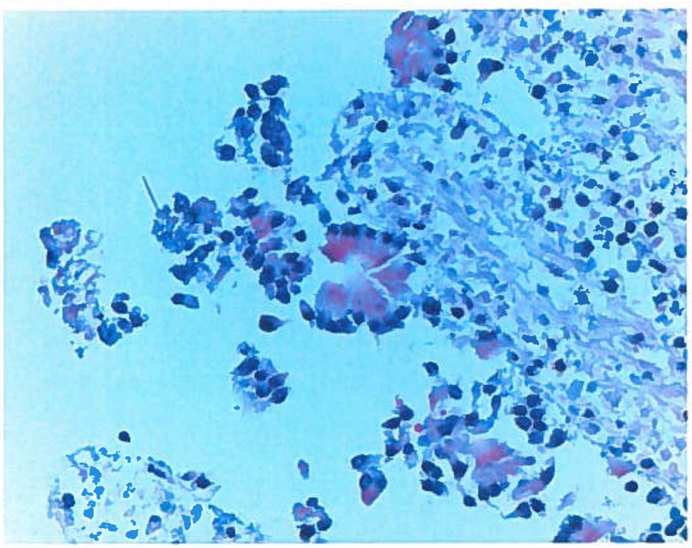
Microscopic examination of intestines and ancillary testing (bacterial culture, viral testing, parasitology) usually required for diagnosis of calf diarrhea.

Calf Gastroenteritis – Diarrhea



← Cryptosporidium on surface of well-preserved intestine

Fresh tissue (i.e. obtained as soon as possible after death) critical for microscopic exam of intestine

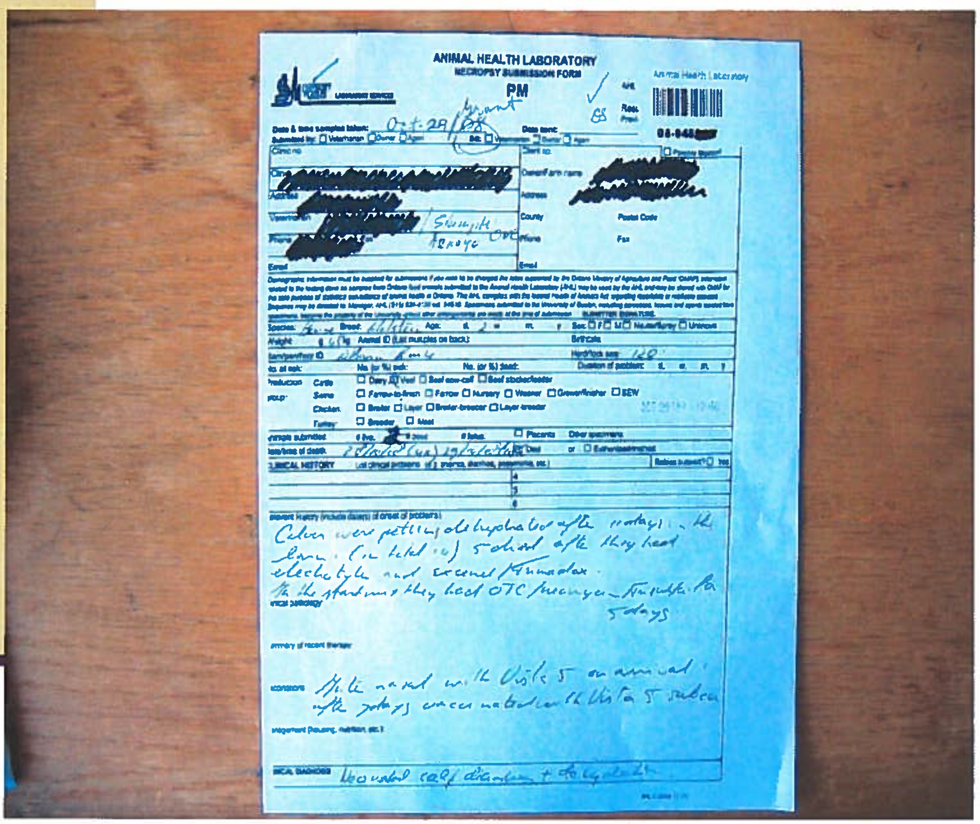


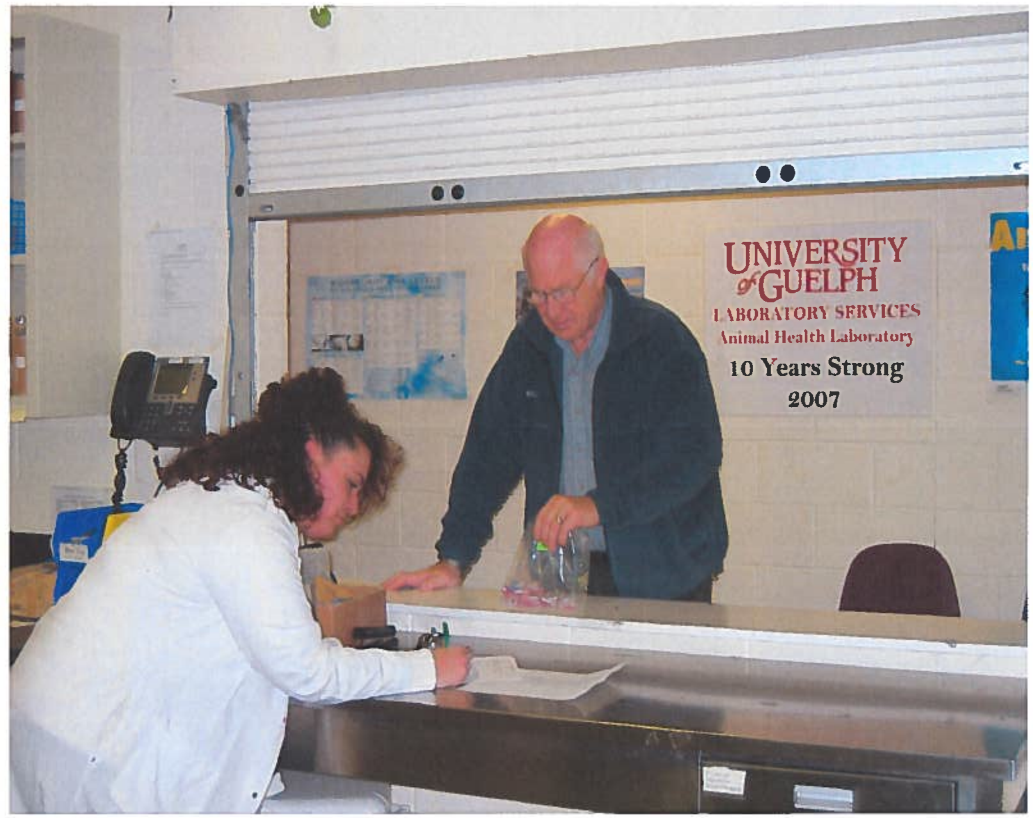
← autolysed intestine with sloughed cells

Necropsy – How?

- History: submission form
- Preparation of body, tools, labels, containers
- Post mortem examination
- Sampling
- Ancillary testing
- Final report

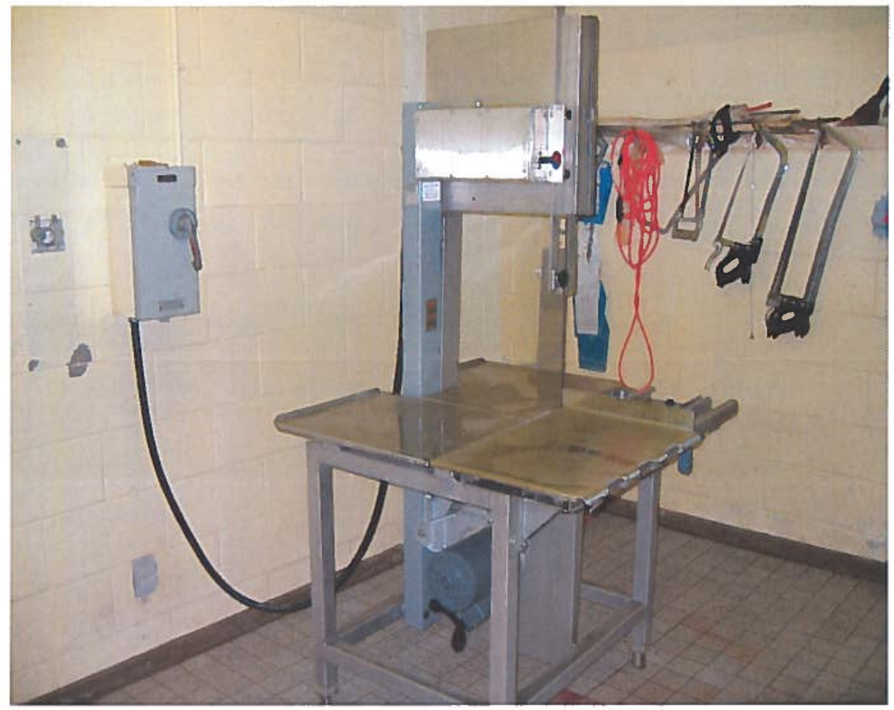
Submission Form



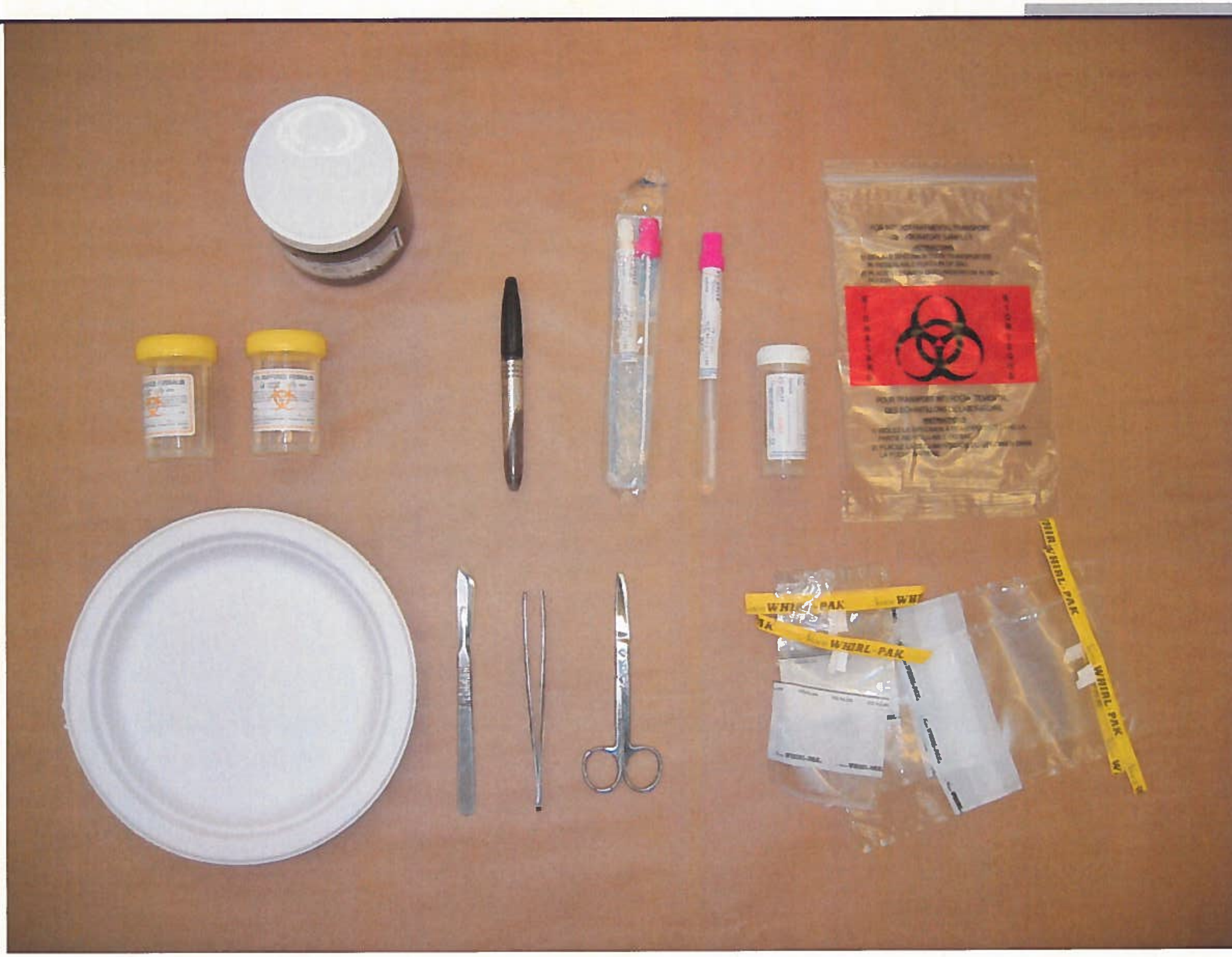


Tools

Tools



Supplies



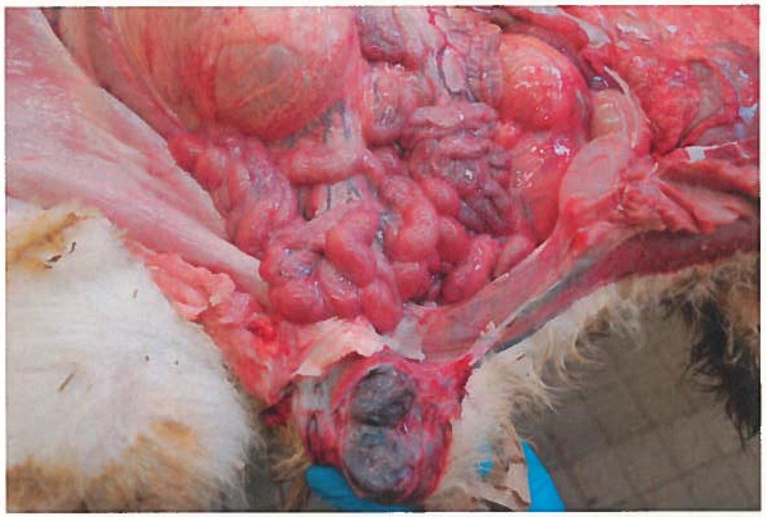
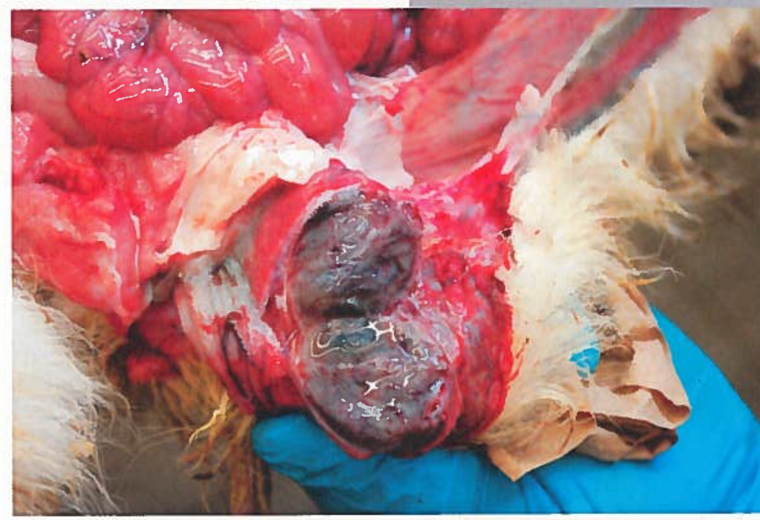
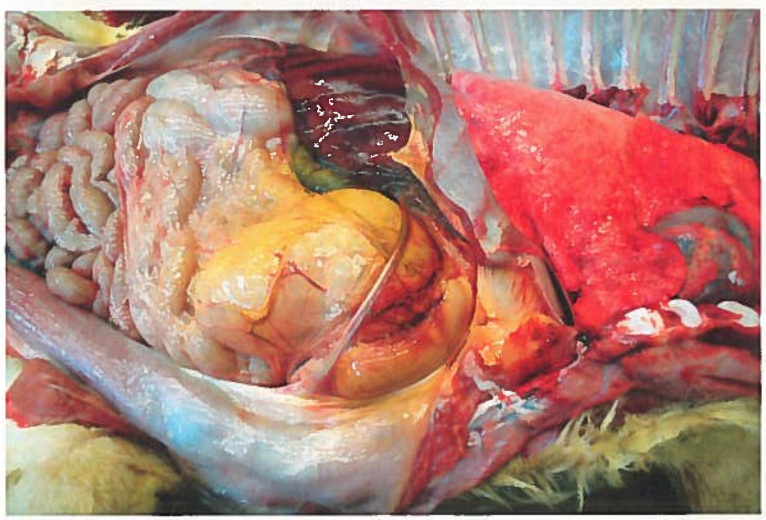
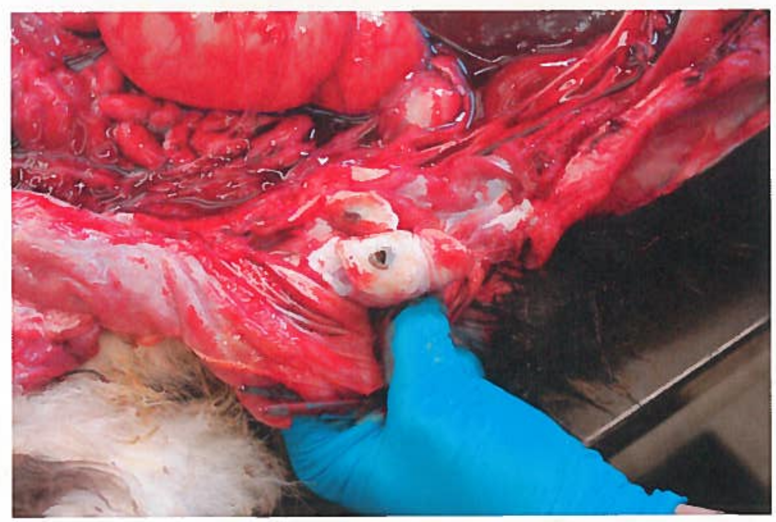
External Examination

- body condition
- hydration status
- color of mucous membranes
- swollen joints, navel
- discharges, diarrhea

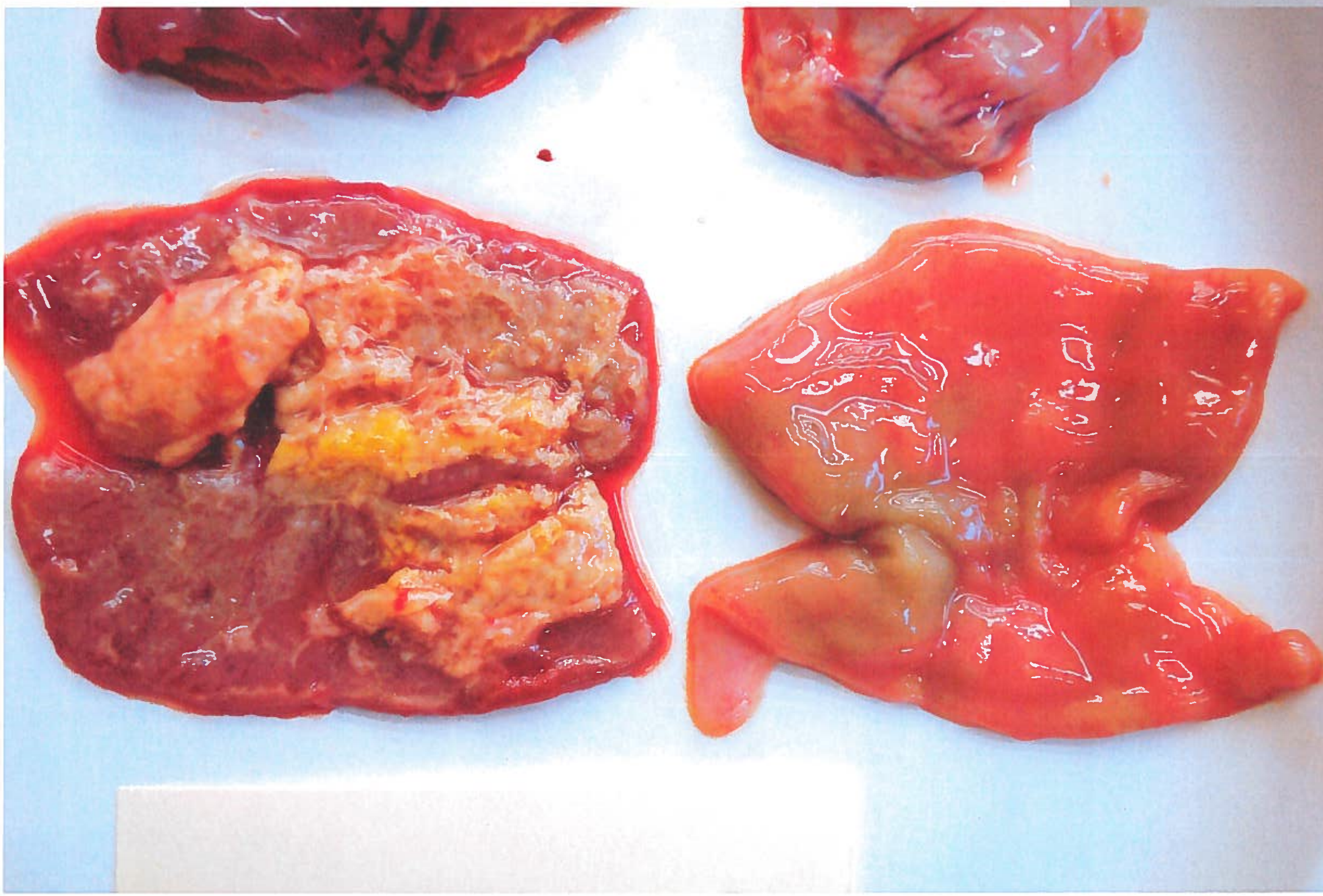
Internal Examination

- examine major body compartments systematically: head, chest, abdomen, limbs
- check tissues for gross lesions: displacements, ruptures, inflammation
- select tissue samples for microscopic examination and fix in buffered 10% formalin
- select samples for ancillary testing:
  - bacterial culture
  - virology: virus isolation, FA, PCR
  - parasitology

Gross Lesion: Omphalophlebitis – Navel Ill

Gross Lesion: Fibrinous Enteritis

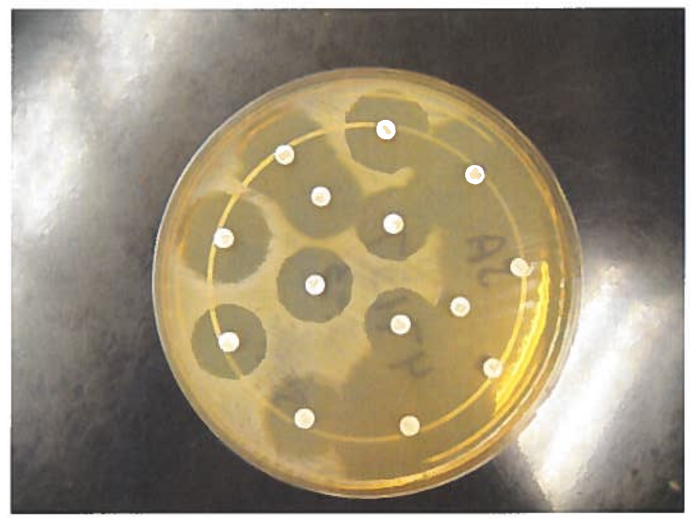


Sampling for:

Ancillary Testing

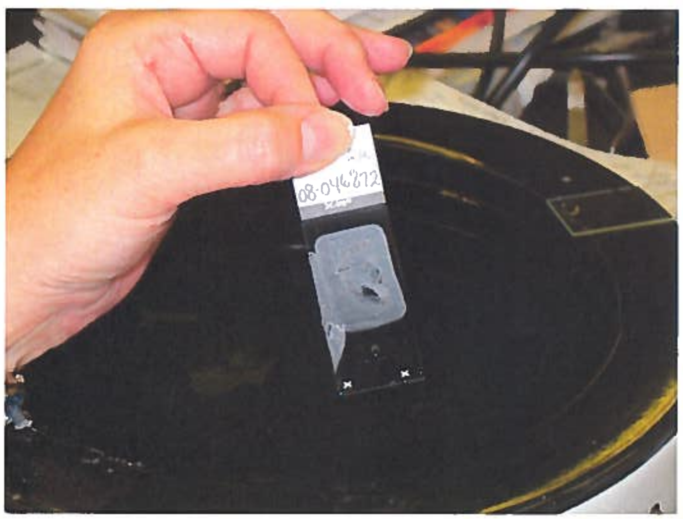
Histology

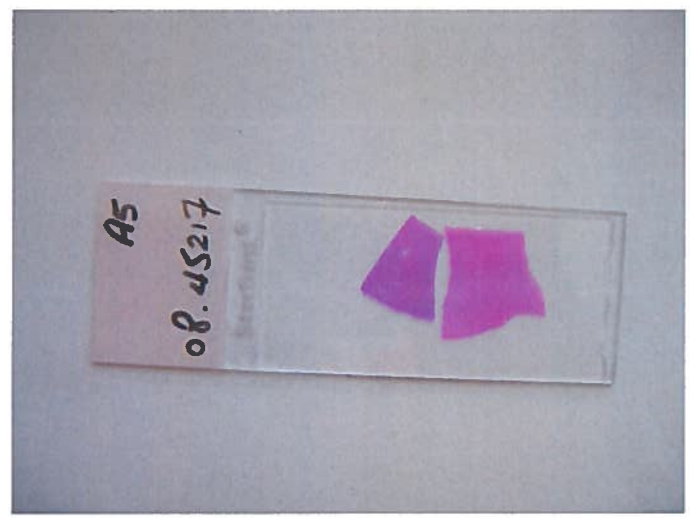
Bacterial Culture



Tissue Fixation and Trimming

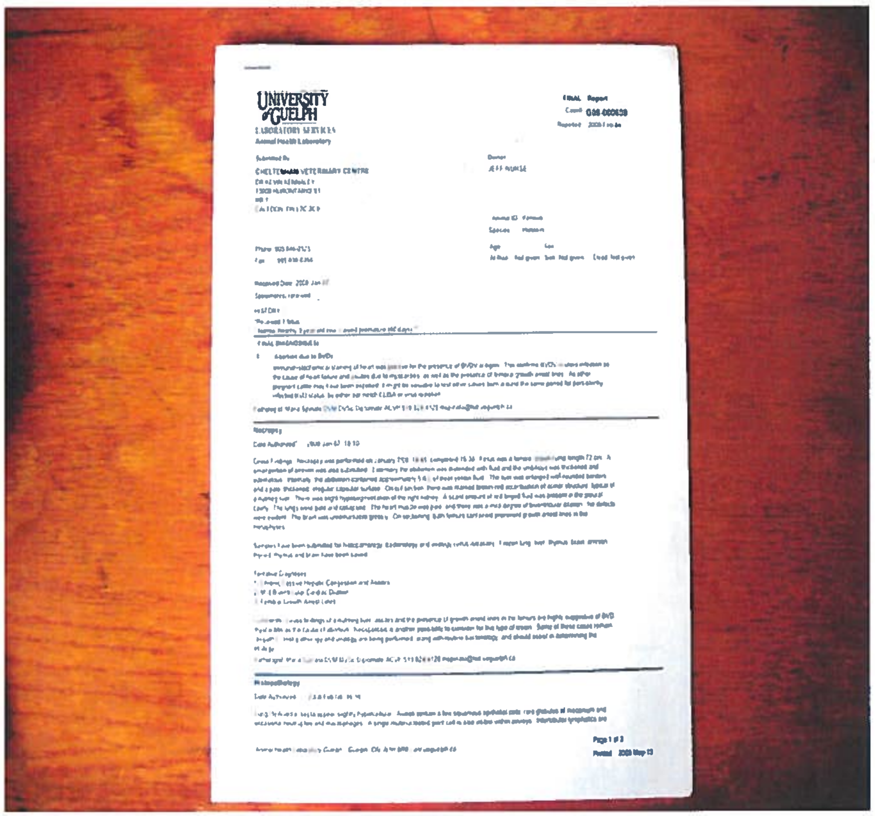
Histology - Slide Preparation





Histopathology – Microscopic Lesions

Final Necropsy Report



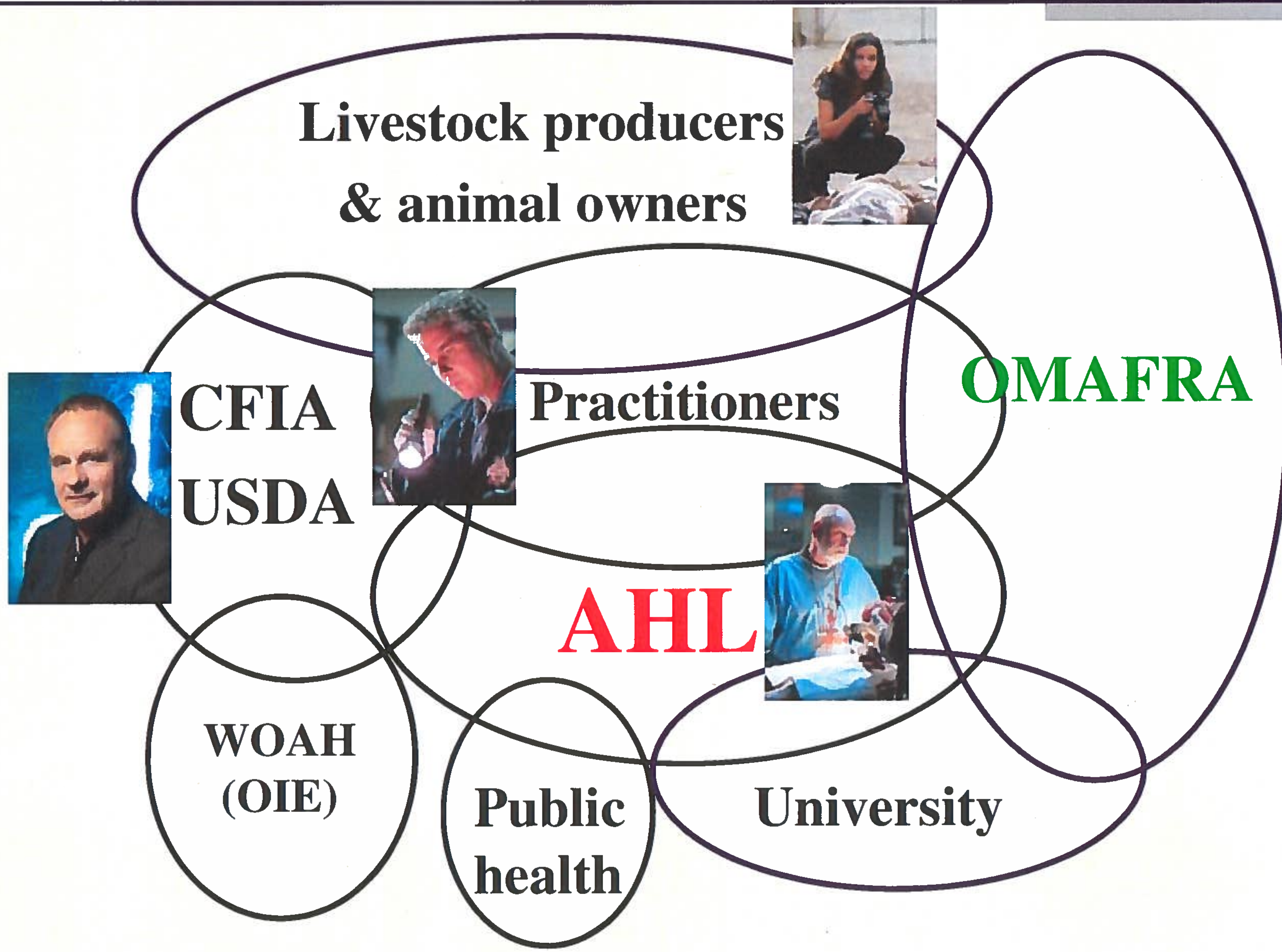
Final necropsy report is written in medical language and includes:

- Contact information (producer, vet, clinic)
- History
- Necropsy findings
- Microscopic findings
- Ancillary test results
- Final diagnosis
- Comments

Final Necropsy Report:

- **History** – 14 calves with diarrhea and dehydration, 5 died
- **Necropsy findings** – 1) Fibrinous enteritis; 2) Subacute omphalophlebitis
- **Microscopic findings** – 1) Marked acute fibrinonecrotizing enterocolitis; 2) Subacute mild fibrinosuppurative omphalophlebitis
- **Ancillary test results** – *Salmonella* isolated; negative for bovine rotavirus, coronavirus, *E. coli*, *Clostridium perfringens*
- **Final diagnosis** – Enteric Salmonellosis
- **Comments** – Omphalophlebitis indicates failure of passive transfer may have contributed to an increased susceptibility to infections.

Partners in Animal Health - "Disease Scene Investigation"

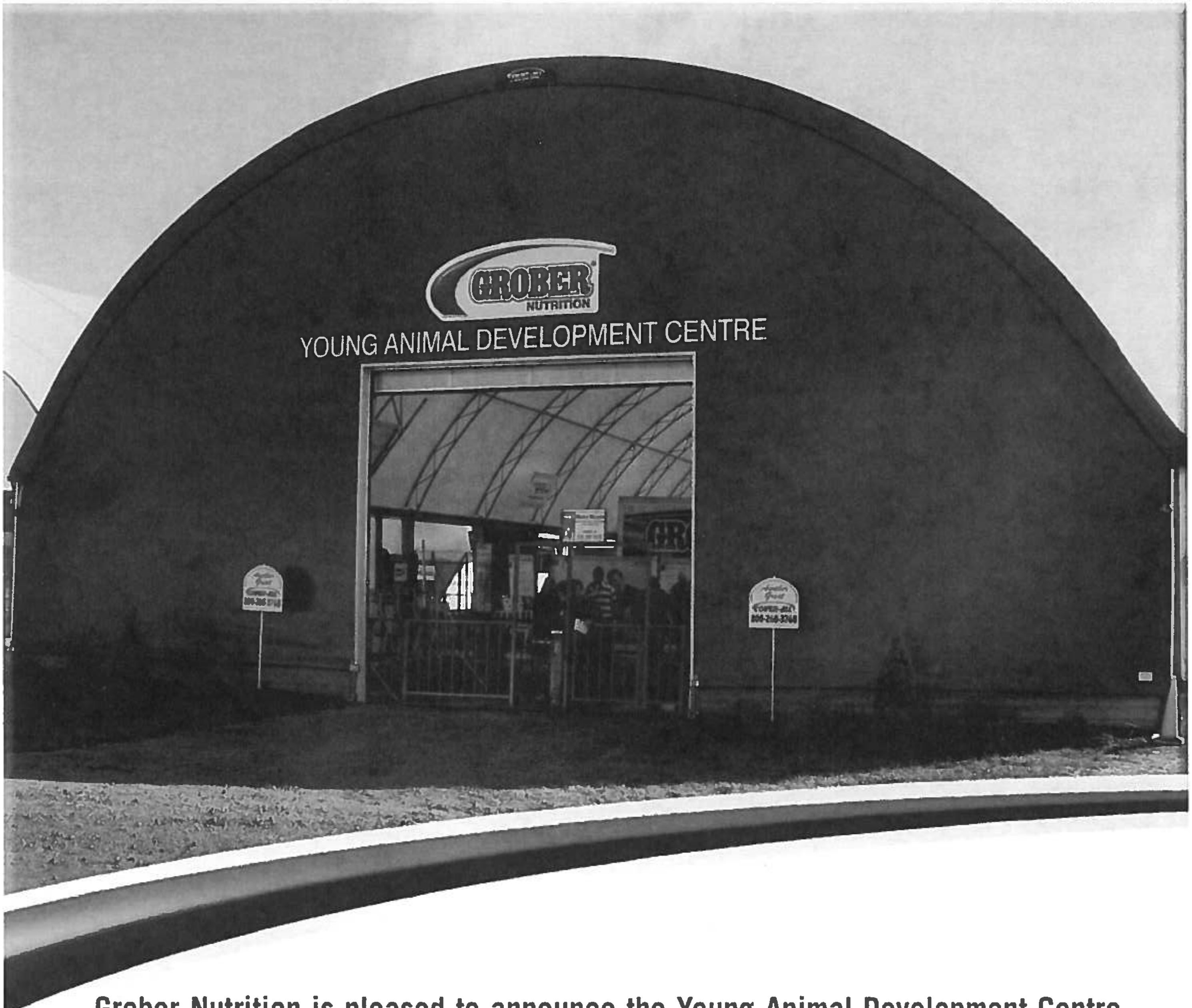


Goal = Healthy Calves

Thanks

- Dr. Jeff Caswell
- Dr. Henry Staempfli
- Dr. Luis Arroyo
- AHL pathologists, microbiologists and technicians

Grober Young Animal Development Centre



Grober Nutrition is pleased to announce the Young Animal Development Centre on the grounds of Canada's Outdoor Farm Show in Woodstock, ON.

Beginning in 2009 the spring-to-fall operation will provide producers, students and industry groups the opportunity to tour a facility exclusively devoted to young animal health and management.

The Centre will feature products and programs relating to: dairy and veal calves, kids, lambs, group and individual housing, and automatic feeding systems.

Please visit www.grobernutrition.com for further details.

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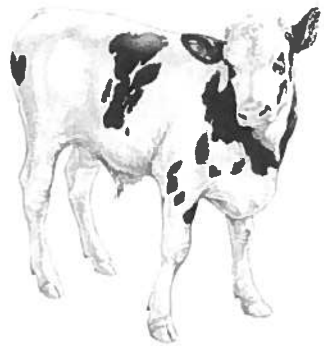

ONTARIO VEAL ASSOCIATION
130 Malcolm Road, Unit #2
Guelph, Ontario, N1K 1B1
Tel: 519-824-2942
Fax: 519-824-2534

www.ontarioveal.on.ca
www.ontariovealappeal.ca
www.calfcare.ca

The Ontario Veal Association is a producer organization dedicated to promoting and enhancing a viable and competitive Ontario veal industry through innovation, marketing, advocacy and education.