PEER REVIEWED

Factors influencing dairy veterinarian necropsy practices and their use of diagnostic laboratories

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Abstract

Dairy herd mortality rates have increased over the last 3 decades but dairy producers appear to be underutilizing veterinarians to perform postmortem examinations. The purpose of this project was to identify dairy veterinarian motivations and barriers for performing necropsies and use of diagnostic laboratories. A 33-question online survey was developed and a link sent to members of a dairy veterinary continuing education group in the western United States. Fifty-two veterinarians responded and many (70%) were offering 12 or more services to their dairy clients, including necropsy. Although 88% of dairy veterinarians surveyed considered necropsy to be a very to extremely useful tool, only 19% said all dairies within their practice utilized necropsy services. The producer's refusal of the service was the primary reason that discouraged practitioners from performing a necropsy (69%), followed by time (44%), cost (38%), and carcass disposal (27%). Factors most commonly reported to promote a necropsy were 'multiple animals affected' (85%) and 'unexplained death' (75%). Because identification of a cause of death could inform herd health management, these results indicate an opportunity to educate dairy producers on the value of necropsy services.

Key words: cattle, dairy, necropsy, survey

Résumé

Le taux de mortalité dans les troupeaux laitiers a augmenté au cours des trois dernières décennies mais les producteurs laitiers semblent négligés les vétérinaires lorsque vient le temps de faire des examens post-mortem. Le but de ce projet était d'identifier les motivations derrières l'utilisation de la nécropsie et des laboratoires de diagnostic de même que les barrières rencontrées par les vétérinaires de troupeaux laitiers. Un sondage en ligne de 33 questions a été développé et un lien a été envoyé à des membres d'un groupe de formation continue en médecine vétérinaire des troupeaux laitiers dans l'ouest des États-Unis. Parmi les 52 vétérinaires qui ont répondu, plusieurs (70%) offraient au moins 12 types de services à leurs clients incluant la nécropsie. Bien que 88% des vétérinaires de troupeaux laitiers considéraient la nécropsie comme un outil très ou extrêmement important, seulement 19% ont mentionné que toutes les fermes laitières dans leur pratique utilisaient des services de nécropsie. Le refus du producteur d'utiliser ce service était la raison principale (69%) qui décourageait les vétérinaires de faire des nécropsies, suivi du temps (44%), du coût (38%) et de la disposition des carcasses (27%). Par ailleurs, le fait que plusieurs animaux pouvaient être affectés (85%) et la mort inexpliquée (75%) étaient des raisons qui encourageaient la nécropsie. Parce que l'identification de la cause de mort pourrait servir à la régie de la santé du troupeau, ces résultats montrent qu'il y aurait un intérêt à éduquer les producteurs laitiers sur la valeur de la nécropsie.

Introduction

On-farm necropsies can guide veterinarians toward a diagnosis and an understanding of disease processes as well as serve as monitors of treatment efficacy and herd health challenges. By performing a necropsy, a veterinarian can collect valuable information that could lead to development of preventive health plans specific to that farm that could decrease disease overall.[24] A postmortem examination can "provide an analysis of dysfunction at the level of the entire animal or even the herd."[13] The main reasons for conducting a postmortem examination include: determination of cause of death, confirming clinical interpretation of mortality, increasing accuracy of diagnosis, monitor production loss and management problems, evaluation of treatment protocols, surveillance of disease trends, emerging and zoonotic diseases, legal documentation, and to monitor the interaction between an animal's health and its environment.[5] Although necropsies can be messy and time consuming, they provide information that can help veterinarians and producers "diagnose and form management and treatment plans to minimize death loss."[19]

Despite the inherent value of necropsies for food animals, a 2007 USDA study of the dairy industry revealed that only 13.3% of dairies implemented necropsies and only 4.4%

of all mortalities were necropsied.[20] The mortality rates in adult dairy cows before that time were 3.8% in 1996, 4.8% in 2004, and 5.7% in 2007 in the United States.[20] In 2014, the USDA reported a death rate of 4.8% and, on average, about 20% of dairy operations used a veterinarian for necropsy services.[21] At this time, however, there is not a standardized mortality rate that dairies can use as a benchmark on the farm.[7] Although not all deaths need to be investigated, to have an accurate overview of herd health a farm should necropsy at least 50% of deaths.[8]

Mortality relates to economic loss to the producer, which includes the value of the deceased animal, labor cost for the antemortem medical management, carcass disposal, lost milk production, and cost for a replacement animal.[6] Dairy mortality rates appear higher in comparison to other industries such as cow-calf operations or feedlots, with death rates of approximately 1 to 1.5%.[6] Beef feedlots, swine, and poultry operations routinely use necropsies to monitor disease to provide preventive medicine through information gained from each death.[6] So why are dairies not incorporating necropsies as frequently as other industries?

Ultimately, the decision to necropsy is based on perceived value by the producer and veterinarian. Factors include veterinarian availability, lack of records, and interpretation of necropsy results at a herd level.[12] Necropsy evaluations can provide insight into management practices and treatment, as well as being a monitor for disease.[12] With obvious benefits of necropsy, veterinarians and producers still appear unconvinced of the value of monitoring cause of death.[9]

Veterinary diagnostic laboratories can play an important role in the diagnosis of cow mortalities. Veterinarians submit samples in hopes of obtaining results that lead to a definitive diagnosis so the information can be used to make effective treatment or management decisions. Veterinary diagnostic laboratories may not be used because of expense, time it takes to receive results, and submissions not leading to a diagnosis.[1] Lack of a diagnosis is often attributed to sample quality and submission style, such as samples from a number of animals in the same container.[22] Samples are often submitted without a history that would otherwise provide context for the pathologist to use in their interpretation.[14]

Identifying motivations and barriers to performing dairy necropsies and sample submission could strengthen the veterinarian-diagnostic laboratory relationship and potentially lead to better diagnoses and prevention plans. The purpose of this project was to investigate necropsy practices of dairy veterinarians in the western United States and identify obstacles that might deter them from performing field necropsies or submitting samples to a lab. The specific objectives were to identify obstacles that prevent dairy practitioners from performing routine on-farm necropsies; identify factors that influence decisions to submit necropsy samples to diagnostic laboratories; and, based on the survey, develop ideas for continuing education that would enhance dairy practitioners' necropsy skills as well as sampling and submission practices.

Materials and Methods

Study Population

Members of the Academy of Dairy Veterinary Consultants[a] were targeted for the survey. The member list included approximately 191 veterinarians in practice, industry and academia, mostly in Western states. A member email list, maintained at the University of California-Davis, served as the mechanism for survey delivery.

Study and Survey Design

The study was cross-sectional and was comprised of a 33-question, online, anonymous survey designed to investigate factors that influence dairy veterinarians' decisions to necropsy and their use of diagnostic laboratories. The Qualtrics online survey software,[b] available through Washington State University, was used as the survey platform. Survey questions fell into 3 categories. Questions 1 through 15 related to necropsy habits of dairy veterinarians, while Questions 16 through 27 pertained to veterinarian's use of diagnostic laboratories. Questions 28 through 33 were demographic questions (Appendix A). Questions were assessed using guidelines for question design provided by Dillman.[4] The study was reviewed and provided exempt status from the WSU Institutional Review Board. Adapting online survey design methods from Dillman, an invitation email (Appendix B) to participate in the survey was sent to the list serve on July 06, 2016, and remained open until August 08, 2016.[4] Weekly email reminders (N=5) were sent to promote participation.

Data Management and Analysis

Data were acquired from the WSU Qualtrics software internal website and exported into a spreadsheet format.[c] Default software graphics and summaries using pivot tables within the spreadsheet were the methods of descriptive analysis. Chi-square contingency table analysis and comparison of proportions were done using EpiInfo V.7.[d]

Results

Respondent Demographics

Approximately 191 individuals were on the Academy of Dairy Veterinary Consultants mailing list in 2015, of whom 75 were in industry or academia and 123 were in private practice. Of those surveyed, there were 52 usable survey responses (individuals that had responded with cattle in their practice) resulting in an overall practitioner response rate of 42%. Graduates from 19 veterinary schools were represented in the study, with 53% having graduated from the University of California-Davis, and Washington State University, combined. Graduation years of respondents ranged from 1970 to 2015 (median = 1998).

About 92% of respondents indicated that the proportion of cattle work in their practice was greater than 75%; 4% reported 51 to 75%; and 4% reported 0 to 25%. Of the 52 survey participants, 78.8% reported that their practice had more than 10,000 dairy cattle, including cows and calves. When asked about different services offered to dairy clients, 71% of participants provided at least 12 different services to the dairies with which they work. The services reported included mastitis/milk quality, calving, farm employee training, record analysis, reproduction, treatment protocols, facility consulting, heifer management, necropsy, surgery, calf management, biosecurity, disease diagnosis and treatment, nutrition, heifer management, financial consulting, or "other" (Figure 1). For the "other" category some participants entered embryo transfer, communication tools and methods, and 1 participant said they sold their practice 2 years previously. Eighty-five percent of respondents provided necropsy services.

Necropsy Practices and Beliefs

Over 88% of respondents believed that necropsy was a very to extremely useful tool on dairies. There was no difference in consideration of necropsies being extremely useful compared to very or moderately useful based on the number of cows in the practice ($P > 0.50$). However, only 19% of veterinarians reported performing necropsies on all dairies within their practice and the majority of respondents (75%) reported that they performed necropsies on "some, but not all" of the dairies in their practice." There was no association between number of cows reported in the practice and performance of necropsy on farm ($P = 0.33$), nor how often a necropsy was performed ($P = 0.13$).

About 80% of practitioners believed there were multiple reasons to perform a necropsy. Two main reasons for influencing a decision to necropsy included "multiple animals affected" and "unexplained death on the dairy" (N=41, N=36, respectively; Figure 2). This question allowed for multiple answers and the majority of respondents chose multiple reasons for performing a postmortem examination. Producer's refusal was the main reason that discouraged practitioners from performing a necropsy (69%), followed by time (44%), cost (38%), and carcass disposal (27%). Some veterinarians commented that their decision to not necropsy was due to carcass degradation, an obvious cause of death, or being comfortable with the cause of death, and apparent lack of threat to the herd. About half the respondents reported that necropsy results were not always recorded.

If gross necropsies were performed on the dairy, a variety of individuals were reported to do them. Forty-eight respondents indicated that a veterinarian performs the necropsy, 18 reported that a dairy employee may do some, and 2 reported using veterinary technicians. Of 48 veterinarians conducting on-farm necropsies, 25% did 1 or more per week, 60% did 1 or more per month, and about 15% reported less than 1 per year. Most (77%) respondents indicated it took 15 to 60 minutes to complete an on-farm necropsy.

No respondent indicated they were "not confident" in their necropsy skills. However, over 42% of respondents reported that they were only "somewhat confident". School and year of graduation (later than 1998 or earlier) were not associated with level of confidence for necropsy skills ($P > 0.15$). Veterinarians reported a wide range of personal necropsy skills that could use improvement. Neurologic disease determination, interpretation of gross findings and disease pattern recognition were the top 3 skillsets that practitioners felt needed improvement (Figure 3). Sixty-seven percent of respondents either somewhat agreed or strongly agreed that veterinary school prepared them to do necropsies. All agreed that veterinary students should be trained how to do gross necropsies. More than 60% were interested in having continuing education related to gross necropsy performance.

Diagnostic Laboratory Submissions

About 65% of respondents reported that submission of samples to a diagnostic laboratory was very to extremely important to them, with others reporting slight to moderate

Figure 1. Number of veterinarians of 52 respondents offering different services to their dairy farm clients.

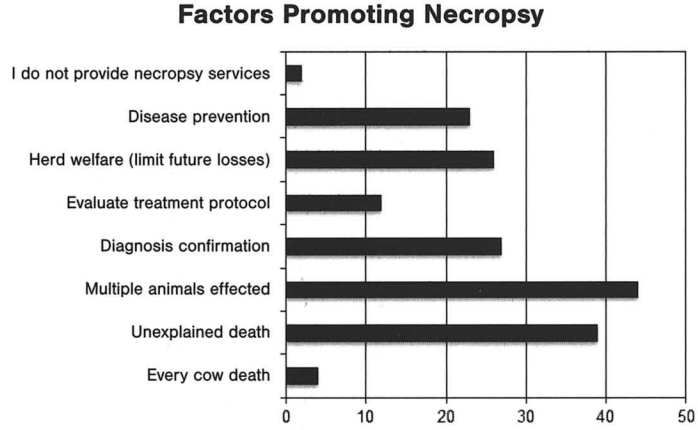

Figure 2. Responses by 52 dairy veterinarians to a question on what factors might promote doing a necropsy on farm.

importance, although most (90%) had submitted samples to a diagnostic laboratory within the previous year. Influences on the decision to submit samples included disease diagnosis (85%), disease outbreak (75%), increased mortality rates (72%), poor response to treatment (53%), abnormal case presentation (51%), and personal curiosity or education (43%). When asked about factors that influenced their decision not to submit samples, the top 2 reasons were producer's decision (67%) and cost (57%), followed by 'diagnosis would not change the treatment option' (47%), confidence in their necropsy interpretations (29%), lab turnaround time (25%), lack of a diagnosis from submissions in the past (22%), and that they did not believe that histopathology was necessary (4%). More than half the respondents (54%) used 2 to 5 different diagnostic laboratories, 41% used only 1 laboratory and 2 used more than 5.

Most respondents (73%) submitted samples 1 or more times a month, 13% submitted samples 1 or more times per week, and 12% submitted less than once per year. The kind of feedback from the diagnostic laboratory veterinarians desired most included a diagnosis (90%), a discussion of differential diagnoses (81%), and suggestions for further diagnostics (67%) (Figure 4).

About 54% of veterinarians were only 'somewhat confident' in their ability to collect appropriate diagnostic samples. There was no association of confidence level with graduation year later than 1998 or earlier. Despite the large proportion (46%) that were very to extremely confident in taking samples, 46 individuals identified some areas upon which they would like to improve including selection of appropriate samples (67%), sample collection technique (41%), sample shipping (37%), and the history and clinical context needed on submission forms (13%). Sixty-five percent were interested in continuing education related to diagnostic sample submission, 6% were not interested, and 29% indicated they might be interested. Eighty-eight percent of practitioners agreed that their veterinary curriculum prepared them to take diagnostic samples, and all agreed that veterinary students should be trained on how to take diagnostic samples.

Discussion

Although 88% of dairy veterinarians surveyed considered necropsy to be a very to extremely useful tool, only 19% of respondents said all dairies within their practice utilized necropsy services. The 2014 USDA NAHMS dairy survey revealed that on average only 23.5% of dairies use veterinarians for necropsy.[21] However, the most common reason why veterinarians did not perform a necropsy was the producer's refusal of the service. This indicates an opportunity to educate producers on the value of a necropsy and an opportunity to educate practitioners on the best way to utilize necropsy findings that can provide insight into farm management.

Death on a dairy is an expense. When a cow dies, the farmer loses the production value of that animal along with any cull value. There is the cost for a replacement animal, followed by a disposal fee for the carcass, and any incurred veterinary or medical costs if the dead cow had been treated prior to death.[26] A financial cost analysis might be necessary to comprehend the importance of increased mortality rates in dairy cattle, which may convince producers that a mortality rate problem affects profitability.[26] In addition to the immediate loss, other cows could be suffering from some condition, with concomitant production losses, that the necropsy could reveal.

In addition to the economic loss, there is value in investigating causes of death from a herd management standpoint. Information gained from 1 death may lead to prevention strategies. "Investigating cause of death is one of the few, and arguably the single most powerful way to assess the outcome of prior treatment, management, and decision-making. Knowing why a cow died and thinking through the chain of events that led to that loss is a powerful means to critique the risks that occur daily on the operation".[10]

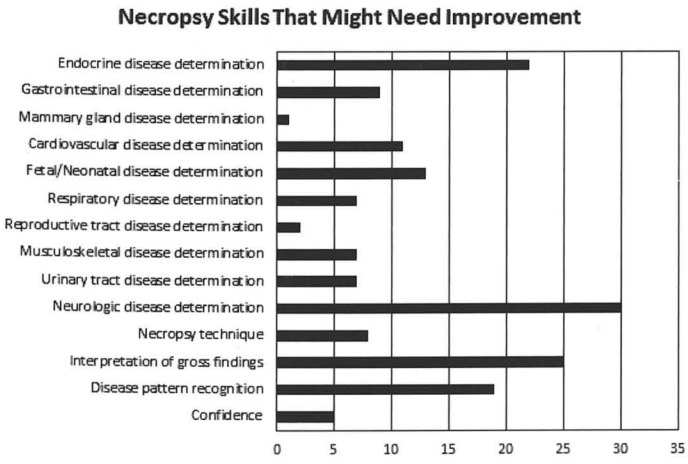

Figure 3. Necropsy skills for which dairy veterinary respondents believe they might need improvement (N = 52).

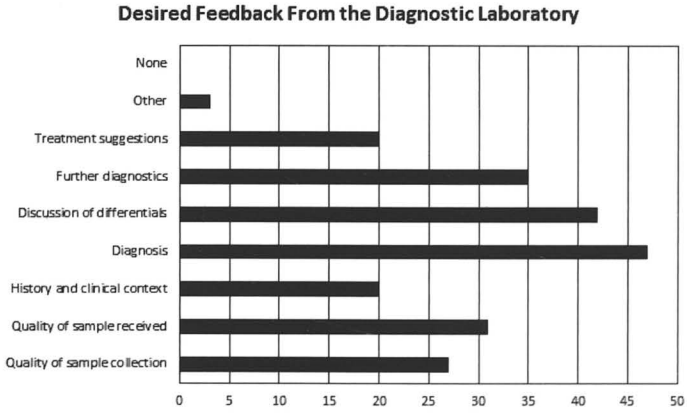

Figure 4. Feedback from the diagnostic laboratory desired by 52 dairy veterinarians.

Necropsy may be seen as an unnecessary use of time by a busy dairy or veterinary practice. The majority of veterinarians reported that a necropsy can take anywhere from 15 to 60 minutes. The time required to complete a thorough necropsy is long initially and may require an hour for novices, but if performed on a routine basis can be shortened by prioritizing organ system evaluation and sample collection given the history and clinical signs. For example, investigating the cause of neurological disease with localization requires evaluation and sampling of eye, brain, liver, kidney, spleen, heart, lung, and adrenal gland, but detailed evaluation of the gastrointestinal tract is not warranted. If the veterinarian does not have time to complete the postmortem examination, dairy employees can be trained and distance or digital necropsy can be initiated at the farm. In our survey, 18% of veterinarians said that a dairy employee performs the postmortem examination. As an example, Feedlot Health Management Services in Alberta has been utilizing digital necropsy since 1995. They train non-veterinarians how they want the carcass opened, the employee follows a set of instructions on which photographs to take, and the photos are uploaded and reviewed by veterinarians.[25] The distance/digital necropsy can provide valuable information as to potential herd health impacts, can be used to create preventive herd health plans, monitor disease, and allows the veterinarian to be involved with herd health even if unavailable for a farm visit.

Postmortem examination is only a piece of the puzzle in managing disease and mortality on a dairy. Information gained during a postmortem needs to be combined with history, stage of lactation, prior medical management and outcomes, and what personnel were involved prior to death.[10] If a necropsy is performed, records need to appropriately describe significant findings, including cause of death. Lameness or injury, mastitis, and calving problems, followed by "unknown" were listed as the leading causes of death in the 2007 NAHMS Dairy study.[20] When analyzing records on dairies, it is common to find the cause of death reported as "SHOT" or "DIGESTIVE", categories not helpful for monitoring disease. On-farm records of disease are often inconsistent and not well defined. These records prevent analysis of overall health and treatments at the herd level.[23] Until a standardized disease reporting system is accepted industry wide, dairies should create consistent, systematic records to record necropsy findings to allow disease monitoring on an individual and herd level.[23]

A recent schema for capturing cause of death and underlying causes of death for monitoring purposes has been proposed.[11] It allows for coding of mortality causes for on-farm record-keeping systems so that they can be more easily summarized. The method involves the use of a dairy death certificate. This document gathers information about the cow, her relevant history and likely causes of death that can inform herd health planning. The death certificate is built around a cause of death statement similar to that used in human death certificates and focuses on capturing the sequence of events leading to a death. Underlying, intermediate, and immediate causes of death can be listed along with necropsy findings and other significant issues or conditions impacting the death. Organizing information relevant to a death within a single form allows for a thorough postmortem analysis that can be effectively distilled into a consistent set of mortality codes for entry and analysis within on-farm record management software. The idea behind these death certificates is to provide meaningful mortality data and promote awareness of each death on the dairy.

A little more than half the respondents were only somewhat confident in their ability to collect appropriate diagnostic samples, and areas in which they wished to improve included selection of appropriate samples, sample collection technique, sample shipping, and history and clinical context needed on submission forms. Food animal veterinarians in Mississippi expressed similar concerns regarding sampling: "Given level of group experience, all participants agreed that there was a need for more practitioner training in diagnostic sampling as they sometimes lacked confidence in knowing what the optimal samples were".[16]

Factors that influenced a veterinarian's decision not to submit samples was mainly due to producer's decision and cost, followed by 'diagnosis would not change the treatment option', confidence in their necropsy interpretations, laboratory sample turnaround time, and lack of a diagnosis from submissions in the past. Veterinarians in Alberta reported downfalls to laboratory analysis to be 'more questions than answers', turnaround time, and degradation of necropsy samples due to autolysis.[17] Alberta veterinarians had similar financial concerns as dairy veterinarians in the west: "Diagnostic laboratory testing needed to be worthwhile from the prospective of producers; diagnostic laboratory testing was cost prohibitive for producers".[17] Mississippi food animal veterinarians said the leading variables preventing submission of laboratory samples were ultimately due to economics associated with sample submission and producer's decision.[16] Diagnostic laboratories should consider some of the reasons for non-submittal and identify areas of improvement, if possible, such as test kits and pre-paid packaging for sample submission. The reasons why veterinarians submit samples to the laboratory were similar between Alberta cattle veterinarians (confirming diagnosis, personal education, and improving self-confidence) and western US dairy veterinarians (disease diagnosis, disease outbreak, increased mortality rates, poor response to treatment, abnormal case presentation, and personal curiosity or education).[17]

About half the respondents were only somewhat confident in their ability to interpret gross findings or collect appropriate diagnostic samples. Respondents proclaimed areas in need of improvement such as collection and selection of appropriate samples, shipping and handling of samples, and relevant history. In addition, results suggest that education on necropsies and sample submission should begin at the veterinary school level. Only half the respondents somewhat

or strongly agreed that veterinary school prepared them for necropsy. Based on these results, some suggestions for veterinary curriculum and continuing education opportunities emerged.

1. Importance of history included with sample submission. Submission of a history is critical for the diagnostic laboratory to have context that will aid in test interpretation.[14] It is common for diagnostic laboratories to receive forms either lacking a history or one that provides little value.[14] At the Animal Disease Research and Diagnostic Laboratory at South Dakota State University, it is estimated that less than 10% of submitted cases contain complete histories (managerial practice of the farm, vaccination protocols, previous disease problems, new additions to the farm, nutritional programs, and any pertinent recent events on the farm that could have been influential to the death).[11] It may be helpful to consider 6 questions when filling out a history for laboratory submission: What is the primary reason for evaluation? What is the duration and frequency of the problem? What are the objective clinical findings? What are the differential diagnoses? What specifically was sampled? What is the appearance of the tissue or lesion? [14]

2. Training in sampling techniques and selection of samples. If time is spent investigating a death by performing a necropsy and submitting samples, it is essential to collect quality samples. Diagnostic laboratories are commonly presented with unusable samples.[5] Some laboratories never offer useful feedback in verbal or written form on samples submitted. Feedback from the laboratory could serve as an educational opportunity for veterinarians and their staff.[22]

3. Training in proper shipping and handling techniques. Proper shipping and handling is not only important for the quality of the tissue sample, but also from a legal standpoint. The AVMA policy "Shipment of Diagnostic Sampling" has been in effect since 1969 and requires veterinarians "to review their methods of preparing diagnostic specimens and ensure that they are in compliance with all applicable guidelines and federal and state laws, which includes required training".[2] Most diagnostic laboratories will provide a general guideline of shipping requirements on their website or they may direct a veterinarian to contact the delivery service they are planning to use to meet the required protocols for shipment of biologic substances.

4. Personal protection during a necropsy. Performing field necropsies leaves a veterinarian (or whomever is performing the necropsy) and bystanders potentially exposed to zoonotic diseases such as tuberculosis, anthrax, and salmonella. Personal protective equipment can also help people decrease the chance of spreading a potential contagious disease to the rest of the herd.[18] Based on our survey, the Washington Animal Disease Diagnostic Laboratory, has created some diagnostic plans to facilitate selection of samples and tests. Adapted from Cornell's Animal Health Diagnostic Center, the diagnostic plans/panels are divided into categories such as adult diarrhea, calf diarrhea, abortions, and respiratory disease.[3] The first diagnostic plan was developed for bovine neurologic disease, as a resource for veterinarians (Figures 5a and 5b).

Conclusions

There appears to be an opportunity for dairies and dairy veterinarians in the west to better utilize postmortem examinations. Postmortem examinations can allow insight into herd health and disease surveillance and influence beneficial changes to management of the herd. The decision to perform a necropsy is influenced by multiple factors, but mainly due to multiple animals having been affected and unexplained deaths. Producer's refusal was the primary reason veterinarians indicated for not performing a necropsy or submitting samples to a diagnostic laboratory. One way to address the lack of confidence in gross necropsy interpretations and sample selection is through focused continuing education.

Endnotes

[a]Academy of Dairy Veterinary Consultants, https://academyofdairyveterinaryconsultants.org/
[b]Qualtrics. https://www.qualtrics.com/
[c]Excel, Microsoft Corp, Redmond, WA
[d]EpiInfo, CDC, Atlanta, GA

Acknowledgments

The authors thank the members of the Academy of Dairy Veterinary Consultants for cooperation with this study. The authors declare no conflict of interest.

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Bovine Neurologic Disease Postmortem
Diagnostic Plan

The following samples and tests are suggested to detect common and high-consequence causes of neurologic disease and are not exhaustive. Please include clinical, herd, and management history, and suspected causes on the general accession form to alert the laboratory about special diagnostic needs. Additional tests are available based on condition suspected or lesions observed. See also Bovine Neurologic Disease Antemortem Diagnostic Plan.

Samples to Submit	Preservation
fixed tissue Minimum: brain, liver, kidney, spleen, lung, heart, lymph nodes, thyroid, adrenal glands, eye, peripheral nerve (e.g. sciatic). Middle ear lining, section of spinal cord if lesion clinically localized. Additional tissues evaluated at no extra cost.	fixed in 10% buffered neutral formalin at 10:1 (formalin:tissue) ratio. Max. 1 cm sample thickness.
fresh (unfixed) tissue 1. CSF (1 mL red top tube) 2. middle ear swabs (use bacterial media + viral transport media): if appropriate 3. aseptically collected brain or brain stem sample[&] 4. pooled aseptically collected liver, kidney, lung, & spleen 5. liver & kidney (individually packaged) 6. eye or ocular fluid	fresh, chilled eye or ocular fluid should be frozen
fresh feces & gastric contents/feed	fresh, chilled

Test Category	Specific Test
Pathology (gross): if applicable*	Necropsy
Pathology (microscopic)	Histopathology
Bacteriology	Aerobic bacterial culture
	Clostridium perfringens fecal culture + PCR
Toxicology	Trace Mineral Screen
	Trace Element Screen
	Nitrates
	Analysis of brain, gastric contents, and/or feed
Parasitology	Fecal floatation

*Rabies: In many states, testing must be pre-approved by local County Public Health Department and performed by State Public Health.

Figure 5a. A proposed template for the Washington Animal Disease Diagnostic Laboratory Diagnostic Plan for bovine neurologic diseases.

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Bovine Neurologic Disease Antemortem Diagnostic Plan

The following samples and tests are suggested to detect common and high-consequence causes of neurological disease and are not exhaustive. Please include clinical, herd, and management history, and suspected causes on the general accession form to alert the laboratory about special diagnostic needs. Other tests are available based on condition suspected or lesions observed. See also Bovine Neurologic Disease Postmortem Diagnostic Plan.

Samples to Submit	Preservation
blood (clotted or serum)	fresh, chilled
blood EDTA (4 mL)	fresh, chilled
CSF (1 mL red top tube)	fresh, chilled
fresh feces & feed	fresh, chilled

Test Category	Specific Test
Serology	*BVDV* AgELISA
	Additional ELISA assays (e.g. *Bluetongue, EHD*, MCF group, *BLV)*
Bacteriology	Aerobic bacterial culture
	Clostridium perfringens fecal culture + PCR
Parasitology	Fecal floatation
Toxicology	Trace Element Screen
	Lead
	Analysis of feed

Figure 5b. A proposed template for the Washington Animal Disease Diagnostic Laboratory Diagnostic Plan for bovine neurologic diseases.

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Appendix A

Dairy Necropsy Survey

Academy members: Thank you for taking the time to complete this survey. There are three sections to this survey. The entire survey should take about 15 minutes. This first section covers necropsy services.

Q1 In your opinion, how useful are necropsy services on a dairy?
- ☐ Extremely useful (1)
- ☐ Very useful (2)
- ☐ Moderately useful (3)
- ☐ Slightly useful (4)
- ☐ Not at all useful (5)

Q2 Are necropsies performed at the dairies with which you work?
- ☐ Yes, all (1)
- ☐ Some of them, not all (2)
- ☐ No (3)

Q3 What factors influence your decision to DO a necropsy?
- ☐ Every cow death (1)
- ☐ Unexplained death (2)
- ☐ Multiple animals affected (3)
- ☐ Diagnosis confirmation (4)
- ☐ Evaluate treatment protocol (5)
- ☐ Herd welfare (limit future losses) (6)
- ☐ Disease prevention (7)
- ☐ I do not provide necropsy services (8)
- ☐ Other (9) _____

Q5 What factors influence your decision NOT to perform a necropsy?
- ☐ Time (1)
- ☐ Cost (2)
- ☐ Producer's refusal (3)
- ☐ Carcass disposal (4)
- ☐ I do not provide necropsy services (5)
- ☐ Other (6) _____

Q6 If necropsies are done on the dairy, are the findings recorded somewhere?
- ☐ Yes, always (1)
- ☐ Sometimes (2)
- ☐ No (3)
- ☐ Not applicable (4)

Q7 If necropsies are done on the dairy, who performs the necropsy?
- ☐ I or a veterinary associate does (1)
- ☐ Veterinary technician (2)
- ☐ Dairy employee (3)
- ☐ Dairy producer (4)
- ☐ Other (5) _____
- ☐ Not applicable (6)

Q8 How often do YOU perform necropsies?
- ☐ One or more per day (1)
- ☐ One or more per week (2)
- ☐ One or more per month (3)
- ☐ Less than one per year (4)
- ☐ Not applicable (5)

Q9 On average, how long does it take you to complete a gross necropsy on a cow?

- ☐ Less than 15 minutes (1)
- ☐ 16 - 30 minutes (2)
- ☐ 31 - 60 minutes (3)
- ☐ More than an hour (4)
- ☐ Not applicable (5)

Q10 How confident are you in your ability to perform a complete gross necropsy?

- ☐ Not very confident (1)
- ☐ Somewhat confident (2)
- ☐ Very confident (3)

Q11 What area of your gross necropsy skillset might need improvement, if any? Choose all that apply:

- ☐ Confidence (1)
- ☐ Disease pattern recognition (2)
- ☐ Interpretation of gross findings (3)
- ☐ Necropsy technique (4)
- ☐ Neurologic disease determination (5)
- ☐ Urinary tract disease determination (6)
- ☐ Musculoskeletal disease determination (7)
- ☐ Reproductive tract disease determination (8)
- ☐ Respiratory disease determination (9)
- ☐ Fetal/neonatal disease determination (10)
- ☐ Cardiovascular disease determination (11)
- ☐ Mammary gland disease determination (12)
- ☐ Gastrointestinal disease determination (13)
- ☐ Endocrine disease determination (15)
- ☐ Not applicable (14)

Q12 Do you agree/disagree that your training in veterinary school prepared you to perform a complete gross necropsy?

- ☐ Strongly disagree (1)
- ☐ Somewhat disagree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Somewhat agree (4)
- ☐ Strongly agree (5)

Q13 Do you agree/disagree that veterinary students should be trained on how to do gross necropsies?

- ☐ Strongly agree (1)
- ☐ Somewhat agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Somewhat disagree (4)
- ☐ Strongly disagree (5)

Q14 Are you interested in continuing education material related to gross necropsy?

- ☐ Yes (1)
- ☐ Maybe (2)
- ☐ No (3)

Q16 How important to you is submission of samples to a diagnostic lab?

- ☐ Extremely important (1)
- ☐ Very important (2)
- ☐ Moderately important (3)
- ☐ Slightly important (4)
- ☐ Not at all important (5)
- ☐ Click to write Choice 6 (6)

Q17 Have you submitted samples to a diagnostic laboratory within the last year?

- ☐ Yes (1)
- ☐ Maybe (2)
- ☐ No (3)

Q18 What factors influence your decision to submit samples to a diagnostic laboratory? Choose all that apply.

- ☐ Disease diagnosis (1)
- ☐ Disease outbreak (2)
- ☐ Abnormal case presentation (3)
- ☐ Increased mortality rates (4)
- ☐ Poor response to treatment (5)
- ☐ Personal curiosity / education (6)
- ☐ Other (7) _____
- ☐ Not applicable (8)

Q19 What factors influence your decision NOT to submit samples to a diagnostic laboratory? Choose all that apply.

- ☐ Turn around time (1)
- ☐ Cost (2)
- ☐ Producer's decision (3)
- ☐ Lack of diagnosis from sample submissions in the past (4)
- ☐ Diagnosis won't change treatment option (5)
- ☐ I am confident in my gross necropsy interpretations (6)
- ☐ I don't believe histopathology is necessary (8)
- ☐ Not applicable (7)

Q20 Approximately how many diagnostic laboratories do you use?

- ☐ None (1)
- ☐ 1 (2)
- ☐ 2-5 (3)
- ☐ More than 5 (4)

Q21 How often do you submit diagnostic samples to diagnostic laboratories?

- ☐ One or more per day (1)
- ☐ One or more per week (2)
- ☐ One or more per month (3)
- ☐ Less than one per year (4)
- ☐ Not applicable (5)

Q22 What type of feedback would you want from a diagnostic laboratory about the samples you submitted? Please check all that apply.

- ☐ Quality of sample collection (1)
- ☐ Quality of sample received (2)
- ☐ History and clinical context (3)
- ☐ Diagnosis (4)
- ☐ Discussion of differentials (5)
- ☐ Further diagnostics (6)
- ☐ Treatment suggestions (7)
- ☐ Other (8) _____
- ☐ None (9)

Q23 How confident are you in your ability to collect the appropriate diagnostic samples?

- ☐ Extremely confident (1)
- ☐ Somewhat confident (2)
- ☐ Very confident (3)

Q24 What area of your diagnostic sample collection/submission, do you feel may need improvement, if any? Please check all that apply.

- ☐ History and clinical context on forms (1)
- ☐ Selecting appropriate samples (2)
- ☐ Sample collection technique (3)
- ☐ Sample shipping (4)
- ☐ Other (5) _____
- ☐ Not applicable (6)

Q25 Do you agree/disagree that your training in veterinary school prepared you to collect the appropriate diagnostic samples?

- ☐ Strongly agree (1)
- ☐ Somewhat agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Somewhat disagree (4)
- ☐ Strongly disagree (5)

Q26 Do you agree/disagree that veterinary students should be trained on how to collect appropriate diagnostic samples?

- ☐ Strongly agree (1)
- ☐ Somewhat agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Somewhat disagree (4)
- ☐ Strongly disagree (5)

Q27 Are you interested in continuing education material related to diagnostic laboratories and sample submission?

- ☐ Yes (1)
- ☐ Maybe (2)
- ☐ No (3)

Q28 Where did you go to veterinary school?

- ☐ Click to write Choice 1 (1) _____

Q29 What year did you graduate from veterinary school?

- ☐ Click to write Choice 1 (1) _____

Q30 Were you taught how to take necropsy samples for submission to diagnostic laboratories while in veterinary school?

- ☐ Yes (1)
- ☐ Maybe (2)
- ☐ No (3)

Q31 What proportion of your veterinary work are cattle?

- ☐ 0-25% (1)
- ☐ 26-50% (2)
- ☐ 51-75% (3)
- ☐ >75% (4)

Q32 Approximately, how many dairy cows are in your practice?

- ☐ Less than 100 cows (1)
- ☐ 101-1000 (2)
- ☐ 1001-5000 (3)
- ☐ 5001-10,000 (4)
- ☐ >10,000 (5)

Q33 What services do you provide for the dairies with which you work? Choose all that apply:

- ☐ Nutrition (1)
- ☐ Reproduction (2)
- ☐ Disease diagnosis and treatment (3)
- ☐ Record analysis (4)
- ☐ Treatment protocols (5)
- ☐ Necropsy (6)
- ☐ Surgery (7)
- ☐ Calf management (8)
- ☐ Heifer management (9)
- ☐ Calving (10)
- ☐ Biosecurity (11)
- ☐ Financial consulting (12)
- ☐ Facility consulting (13)
- ☐ Farm employee training (14)
- ☐ Mastitis / Milk quality (15)
- ☐ Other (16) _____

Appendix B

Cover Letter and Survey Questions

July 5, 2016

Dear Member of the Academy of Dairy Veterinary Consultants,

My name is Sierra Salopek, and I am a fourth year veterinary student at Washington State University. I am seeking your assistance in completing a short online survey for my research project. For my senior paper, I have created a survey with Dr. Dale Moore, to explore the factors that influence a dairy veterinarian's decision to perform gross necropsies and to submit samples to diagnostic laboratories.

In order to accurately represent the larger population of dairy veterinarians, members of ADVC were chosen because of their belief in continuing education and for the diversity of experience and knowledge amongst its members.

A 2007 USDA study revealed that only 13% of 9,750 dairy operations performed necropsies and only 4.4% of animals are necropsied.[1] Yet, there are many articles about why postmortem evaluations can be a great resource to dairy herd management and welfare. Dairy cow mortality is an important factor in the understanding of overall herd health but there are likely many barriers to being able to carry out postmortems on client farms. With this in mind, and my interests in dairy medicine and pathology, I want to explore what factors influence the decision to necropsy and submit diagnostic samples.

The online survey will be available July 5, 2016 – August 1, 2016 at 5 PM. It can be accessed via the following link: [insert link here].

I would like to personally thank you in advance for participating in this research. Your time and opinion are greatly appreciated, and it is because of people like you and your contributions to research that greatly impact the future of dairy medicine.

Sincerely,
Sierra Salopek
Washington State University
College of Veterinary Medicine
DVM Candidate Class of 2017