help inform novel ways of addressing routine challenges within our livestock herds. My first foray into integrating lessons learned from human epidemiology came in the form of the dairy death certificate that my PhD mentor, Dr. Frank Garry, and I developed as a means for capturing the “how” and “why” underlying dairy cow mortalities as opposed to simply focusing on “what” pathology led to the proximate cause of death.

Over the years we’ve expanded the conversation to apply the concept of a disability-adjusted life year (DALY) summary measure of health to dairy population medicine. I went into some detail regarding this line of research in the FDUI Research Update within the Winter 2022 newsletter. The DALY was developed in the 1990s for use in human medical epidemiology to measure overall disease burden, expressed as the number of years lost due to ill-health, disability, or early death. It is a metric used by the World Health Organization to assess the global burden of disease. Our goal is to measure the lifetime burden of dairy cow diseases and disease sequelae by aligning standard measures of productivity with physiological impacts described through clinical assessments and molecular diagnostics.

Underlying much of this research is the perspective that it can be useful to frame today’s animal agriculture as essentially the urbanization
of livestock production, similar to the Industrial Revolution of 18th and 19th century Britain shifting human populations from a homogenous agrarian lifestyle to an increasingly diverse, mechanized and urbanized setting. As such, we can take a page out of ongoing modifications and adaptations to healthy urban planning (HUP) for humans, as we continue our efforts to achieve the best health and well-being within our livestock municipalities.

It's not much of a stretch to extend to livestock production most of the 12 objectives adopted for the HUP theme. These objectives relate to the sequence of spheres on the health map below (Figure 1) and include the following:

- Promoting healthy lifestyles (especially regular exercise)
- Facilitating social cohesion and supportive social networks
- Promoting access to good quality housing
- Promoting access to employment opportunities
- Promoting accessibility to good quality facilities
- Encouraging local food production and outlets for healthy food
- Promoting safety and a sense of security
- Promoting equity and the development of social capital
- Promoting an attractive environment with acceptable noise levels and good air quality
- Ensuring good water quality and healthy sanitation
- Promoting the conservation and quality of land and mineral resources
- Reducing emissions that threaten climate stability.

These objectives certainly ring true across the spectrum of quality facilities, sanitation, and even social networks that influence livestock health and well-being. That said, the comparison falls a bit flat with regard to employment opportunities and the development of social capital if the focus is solely on livestock. However, if the farm is viewed holistically (inclusive of those determinants influencing farm personnel) then the networks of relationships among people who work on the farm enable it to function effectively through interpersonal relationships, shared understanding, shared norms, shared values, trust, cooperation, and reciprocity.

Figure 1. Determinants of health and well-being
This brings up a key point regarding the importance of communication within the complex organizational structure of our urbanized farms. A previous study conducted through WSU Veterinary Medicine Extension explored improving dairy organization communication from the veterinarian’s perspective (J. Vet. Med. Educ., 2016; 43(1): 33–40). At the heart of that study was the thought that the increasing size and complexity of US dairy farms could make it more difficult for a veterinary practitioner to effectively communicate protocol recommendations for prevention and treatment decisions on the farm. The results highlighted the need for training to improve communication with clients and farm employees. A follow-up study (J. Dairy Sci. 2021, 104:3197-3209) described on-farm worker communication networks and information sources used by employees to support decisions regarding calf health. The main information sources for problem solving and skill improvement proved to be within the farm and generally from middle managers and other employees. Veterinary expertise was used, but it was not commonly accessed unless veterinarians were involved in training. Importantly, communication between workers and management diminished for daily work as compared with goal setting.

All this to say that the complexities of increasingly diverse, mechanized, and urbanized livestock production may benefit from novel approaches to management and oversight. Taking a page out of the HUP approach might provide the basis for improved dialogue among farm personnel. Just as actors and decision-makers at all levels and from many sectors have a role in designing healthy, resilient cities, farm employees have the closest interaction with everyday environments and can provide a key contribution by supporting managers in identifying needs and priorities, ensuring continuity in long-term objectives, and strengthening employee buy-in and participation.

Per the recently published Integrating health in urban and territorial planning: a sourcebook, health is the “pulse of the New Urban Agenda”, with urban planning serving as the circulatory system taking that pulse of health into all aspects of human settlements. Changes to HUP can be triggered by using a health lens as outlined in Table 1 below. Ultimately, whether we’re talking about municipalities establishing government structures to address the needs of the people—or farms establishing an alliance of stakeholders to minimize conflict and unintended negative consequences—the idea is to avoid working in silos by coordinating policy across a wide variety of environmental, social, and economic domains.

<table>
<thead>
<tr>
<th>Health provides new inputs</th>
<th>Health changes the participants</th>
<th>Health improves the planning system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bringing a new cadre of professional expertise into UTP</td>
<td>Urban planning stakeholders (professional, policy and community):</td>
<td>Improved planning systems through performance targets aligned to achieving health and health equity</td>
</tr>
<tr>
<td>Providing a new set of population-level tools for assessing impacts on risk to health from “business as usual” planning and design options</td>
<td>• understand how the health sector can contribute to UTP</td>
<td>More effective planning for improved population outcomes across a range of health and well-being targets</td>
</tr>
<tr>
<td>Providing a rich evidence base and set of empirical skills to inform decisions</td>
<td>• understand how UTP can support health and well-being</td>
<td>Ability to meet a wider range of SDG targets through UTP interventions</td>
</tr>
<tr>
<td>Building capacity for health literacy amongst professionals and communities through training, mentoring and coaching</td>
<td>• better understand existing health need, place-based situations and how to develop robust solutions</td>
<td>A legacy of joint tools, approaches, relationships and understanding</td>
</tr>
</tbody>
</table>

Table 1. Changes to urban planning triggered by using a health lens (Integrating health in urban and territorial planning: a sourcebook. Geneva: UN-HABITAT and World Health Organization, 2020.) UTP: urban and territorial planning. SDG: sustainable development goal.
Anthelmintic resistance is a growing concern in small ruminants. Many factors affect the development of anthelmintic resistance, but veterinarians and small ruminant producers can lessen the impact of anthelmintic resistance by implementing strategic deworming schedules formulated using objective measurements of worm burdens. The general aim is to treat animals as few times as possible to avoid excessive selection pressure for creating resistant populations of nematodes. At the same time, there should be enough deworming treatments to avoid parasitic disease in herds and flocks. Detailed information about individual farms including parasite history and management structure is necessary to develop useful anthelmintic recommendations, but key elements can form a basic scaffold from which to build a specific deworming program.

Overall, appropriate pasture management is the most important factor in reducing strongyle nematode burdens. Ruminants shed strongyle eggs in the feces, and the hatched larvae contaminate the pasture, infecting ruminants that graze these pastures. **Treatment of grazing animals in spring, early in the grazing season, helps to prevent initial pasture contamination and reduce pasture parasite levels over the course of the summer.** Strongyle nematodes prefer the warm, wet spring and summer weather. The larvae thrive on pasture throughout these seasons and the adult worms readily produce eggs in the gastrointestinal tract all summer long. Whether small ruminants require treatment during the summer is dependent on many factors, including weather and farm conditions.

The best and most objective way to determine whether mid-summer anthelmintic treatment is necessary is to perform a quantitative fecal float. Ruminants shedding high levels of strongyles (typically greater than 200-300 eggs per gram) should be treated to prevent further pasture contamination. Small ruminants harboring *Haemonchus contortus*, also known as barber pole worms, are the most at-risk for severe disease and death. The eggs produced by *H. contortus* cannot be differentiated from other strongyle nematodes on a fecal float but can be identified specifically using the *Haemonchus contortus* fluorescent assay available at WADDL (Figure 1).

Additionally, anthelmintic efficacy can be evaluated on individual farms by performing a Fecal Egg Count Reduction Test (FECRT) during the summer season. This test involves submission of a fecal sample before deworming and again 10-14 days after deworming to ensure that egg numbers are decreasing following anthelmintic treatment. All of these testing modalities to quantify strongyle egg counts, detect *H. contortus*, and evaluate FECRT to assess anthelmintic efficacy are available at WADDL, and can be used in the development of strategic anthelmintic schedules on an individual farm.

More information is available through the WADDL website at [https://waddl.vetmed.wsu.edu/goats/](https://waddl.vetmed.wsu.edu/goats/). Veterinarians and producers alike can work together to lessen the impact of anthelmintic resistance and ensure the future of small ruminant production in our region!
A bill recently passed through the Oregon Senate that proposes to eliminate the mandatory brucellosis (bangs) vaccination requirements in that state for both beef and dairy cattle. If enacted, Oregon would join a growing list of Western states that have either rescinded or scaled back their Bangs vaccination regulations in recent years. To date, there are only 4 other States that require mandatory brucellosis vaccination in beef cattle (Idaho, Wyoming, Nevada, and North Dakota) and 6 states requiring vaccination in dairy cattle (Idaho, Wyoming, Nevada, North Dakota, California and Arizona). Recent data suggests that 4 million calves are still vaccinated for brucellosis: 32% of dairy and 25% of beef operations through mandatory or voluntary programs.

The brucellosis eradication program, started in 1934, has proven to be successful with vaccination and test/cull strategies. At the beginning of the program, brucellosis was widespread throughout U.S. livestock, but eradication and vaccination efforts have had dramatic results. In 1956, there were 124,000 affected herds in the U.S. By 1992, this number had dropped to 700 herds and the number of affected domestic herds has since declined to single digits in the last decade. In 2009, all 50 states were declared to have “free” status by USDA. Today, brucellosis is only found in the Greater Yellowstone Area where approximately 50% of bison and 30% of elk remain infected. Since 2010 an average of 2.6 cattle herds have been infected in the GYA. The three states around Yellowstone National Park (Idaho, Montana and Wyoming) have each created a brucellosis Designated Surveillance Area (DSA) within their respective states. Livestock that graze in or near the DSA have brucellosis testing requirements for movement out of the region and at change of ownership. Vaccination and identification requirements are also strictly enforced.

Robust slaughter surveillance programs have provided an effective mechanism to rapidly monitor, identify and track positive animals. Around two million animals are tested annually, with 22,558 samples tested from Washington cattle alone in FY 2020. The number of cattle sampled is sufficient to detect with a 95% confidence a 0.001% prevalence (less than 1 in 100,000 animals). USDA is confident slaughter surveillance and private veterinary testing based on clinical signs in herds will capture any positive herds. Because vaccination does not prevent infection, some state veterinarians speculate that RB-51 vaccination may actually slow detection by eliminating abortion storms in affected herds.

With mounting pressure from other states and USAHA to harmonize interstate movement regulations, WSDA wants to hear from you about whether brucellosis vaccination should remain mandatory in Washington State. At the end of the day, WSDA is here to promote the economic vitality of the livestock industry by minimizing exposure to animal diseases and enforce the regulations that are important to you. We also want to be sure that we review our regulations to make sure that they are relevant for the time, promote business continuity and remain based on sound science. Changes to our rules should be driven by industry and the private accredited veterinarians performing regulatory work, so it is critical that we get your feedback to better inform these key decisions. Some veterinarians have reported that they would like to move away from vaccination due to the science showing low risk, others report a lack of time and overburdened workloads to continue a mandatory program, whereas others say it is the ‘gateway’ to getting on farms to establish a VCPR, and some rely on the income associated with the work.

Our Animal Disease traceability program depends on regulatory animal health documents and the application of individual official identification by accredited veterinarians. While you think about whether to make the brucellosis vaccination program voluntary, we are also looking for feedback as to how to continue incentivizing tag use for rapid response and disease containment in Washington. Feel free to reach out and share your ideas.

aitle@agr.wa.gov
WADDL: An Update on Diagnosis of Neospora Caninum-Induced Abortion in Cattle—What Does a “Positive” Test Mean?
By Dr. Garry Haldorson, College of Veterinary Medicine

Neospora caninum was first identified as a unique pathogen in the 1980’s, having been misidentified as a new subspecies of Toxoplasma up until that time. This protozoal organism causes neurologic disease in dogs and abortions in cattle. In the 1990’s, Neospora diagnosis as the cause of abortion outbreaks within herds was commonplace. Although Neospora-induced abortion epidemics still do occur, it is much more common to see sporadic or endemic abortions within a given herd today.

Diagnosis of Neospora as the definitive cause of an abortion can be difficult. Although there are multiple tests available to diagnose infection including serology, histopathology, immunohistochemistry, and molecular diagnostics (PCR), interpretation of test results requires an understanding of the life cycle and epidemiology of the organism. Before we discuss test interpretation, we should understand what each test actually is evaluating, add in our knowledge of the organism’s life cycle, and then discuss the difficulties in diagnosis.

Diagnostic Testing
Serologic testing (ELISA performed at WADDL for cattle) tests for exposure to the organism. An elevated titer requires that an animal be exposed to the organism, become infected, and mount an immune response measured by the production of antibodies specific to that organism. As with most infectious diseases, it can be difficult to equate the presence of antibodies or even the actual antibody titer to current infection versus previous exposure. In addition, even though the dam would have to be exposed and infected in order to mount a serologic titer, it does not necessarily mean that this infection was the actual cause of abortion (more on this after we discuss epidemiology).

The second test mentioned is histopathology. If a fetus is aborted due to infection with Neospora caninum, pathologists would expect to see histopathologic changes in the brain and hopefully within at least one additional tissue (such as heart). This obviously implies that the fetal tissues would have to be available for collection and submission for a bovine abortion panel. Although the lesions of Neospora can be multifocal, they tend to be numerous enough that multiple lesions will be identified even with the random nature of sections of brain, heart, and other tissues processed for histopathology. In short, if there are not enough lesions to be identified by histopathology, it is unlikely that the abortion was due to Neospora. Furthermore, it is often possible to identify protozoal tissue cysts within sections examined microscopically, and this also greatly aids in the diagnosis. However, observing the tissue cysts is less consistent than identifying the histologic foci of necrosis and inflammation that infection leaves behind.

Immunohistochemistry (IHC) was traditionally used as a confirmatory test after seeing lesions microscopically. IHC would be positive in tissues where Neospora antigens are present, and if that positive immunoreactivity was present in the foci with histologic changes, it would confirm Neospora as the cause of those changes. With the higher sensitivity of PCR, IHC has been replaced by PCR as the gold standard for diagnosis of infection. Given the expense of maintaining antibodies for IHC and the overall expense of IHC, IHC for Neospora is no longer offered at WADDL.

As mentioned, the sensitivity of PCR for diagnosis of infection makes it ideal for identifying the organism within tissues. This test can identify as few as one organism in one gram of tissue. In addition, the PCR used for Neospora at WADDL is a duplex PCR that also will detect Toxoplasma if present. Given that Toxoplasma would be the primary differential for the microscopic lesions seen with Neospora, testing for both organisms at the same time greatly enhances the test’s value, even though Toxoplasma would be a much less common cause of
abortions in cattle. Still, it is actually the sensitivity of the PCR test for *Neospora* which further complicates its interpretation in bovine abortions (more on this after discussing the life cycle and epidemiology of infection).

*Neospora caninum* life-cycle and epidemiology

Dogs and coyotes (as well as dingoes and gray wolves) are the only known definitive host species for *Neospora caninum*. This means that only these species can be infected orally with the organism and later produce infective oocysts in their feces. Other species including rodents, rabbits, birds, cats, cattle, wild mammals, sheep, and goats, (among many other species), can serve as intermediate hosts. When exposed to the infective oocysts orally, these intermediate hosts will become infected and have the protozoa migrate systemically, ultimately forming tissues cysts filled with a life stage of the organism called bradyzoites in various tissues. However, these species will not produce infective oocysts in their feces. Instead, in these species the tissue cysts serve as a reservoir of infection that if consumed by the canine definitive host will infect the dog allowing completion of the life cycle.

In infected cattle, there is a third life stage called the tachyzoite that can spread within the host and also cross the placenta to infect an unborn fetus. Some of these infected calves will die in utero and subsequently be aborted. (Notably, infected fetuses and placentas can serve to perpetuate the organism’s life cycle if consumed by canines). However, many cows will transmit the parasite to the fetus, but the fetus will survive (often with no clinical signs). That calf will be infected for its life and potentially transmit the parasite to its offspring. In these cases, cows that had been infected and have had parasites in their tissues in the form of tissue cysts will have recrudescence of infection at around 5 to 7 months of gestation. At that time, the parasite that was within tissue cysts in the bradyzoite phase will be released from the cyst as the more rapidly dividing tachyzoite phase and those tachyzoites will go on to infect the developing fetus. If that infection of the fetus is severe enough and causes many lesions in multiple tissues the calf will be aborted. On the other hand, if the infection is limited the calf will be infected but not aborted. It appears that this “vertical transmission” from cow to calf, in addition to contamination of feed sources with the feces from infected wild or domestic canines, serves to perpetuate infection within a given herd. The mechanism of perpetuation in beef herds (infection from contaminated feed vs. vertical transmission) is less well defined. Direct infection from cow to cow (“horizontal transmission”) does not occur.

In naïve cow herds that have never been exposed to *Neospora caninum*, infection of feed will tend to produce “abortion storms” where several cows will abort at around the same time (shortly after the contaminated feed was consumed). Once *Neospora* becomes endemic within a given herd, many of the cows will become persistently infected and develop some degree of immunity. This immunity will not clear the infection in the cow and will not prevent recrudescence of infection and thus will not prevent spread of infection to the fetus. However, it does seem that the immunity is able to limit spread to the fetus and prevent abortion from occurring. This is demonstrated by the finding that primiparous heifers and cows that become infected for the first time as adults will tend to abort more commonly, whereas in subsequent pregnancies cows will most often
produce live and healthy (though infected) calves. Attempts to develop an effective vaccine that will either clear infection or even just reduce the likelihood of abortions occurring have thus far been unsuccessful.

**Difficulties with Diagnosis**

Limitations of the available diagnostic tests and complexities of the life cycle of the organism result in difficulties with diagnosis of *Neospora* either as the cause of a given abortion or as a tool in disease management. As stated, serology is a measure of exposure and infection within the cow. Worldwide estimates of seropositivity in cows range from 15 to 40%, but within a herd infection rates can be as high as 90%. Thus, the use of serology as a potential test to identify infected cattle for the purpose of culling is troublesome. It could result in the loss of valuable genetics while not doing anything to prevent re-exposure by farm dogs or visiting coyotes. Furthermore, using serology of the cow in diagnosis of abortion is problematic at best. If seroprevalence in a herd is high, a positive titer would not be useful in confirming that the abortion was due specifically to *Neospora*. In addition, documenting rising titers (commonly used to differentiate preexisting infection or exposure from active infection) does not work well with this organism. As discussed above, infected cows will typically harbor an infection for life in the form of inactive tissue cysts. At 5 to 7 months of gestation, something triggers these cysts to rupture and release the tachyzoite phase of the organism’s life cycle, which will then very efficiently cross the placenta and infect the calf. This stage of gestation is correlated with an increase in antibody titers in the cow. Unfortunately, this increasing titer will occur in cows that abort due to *Neospora*, but also in cows that transmit the organism to what would otherwise have been a healthy (but infected) calf that was actually aborted due to a completely different cause. In effect, we expect to see a rising antibody titer in all infected cows at mid-to late gestation whether or not they abort due to *Neospora*.

Histopathology has a distinct advantage over serology in that the pathologist is looking at the fetal tissues for actual lesions associated with infection. Large numbers of lesions in the brain and other tissues of an aborted calf greatly increases the suspicion that *Neospora* was the cause, which can then be confirmed by PCR. If only one or a very few lesions are seen, then interpretation is difficult. As discussed, it is expected that a calf from an infected cow will be infected at birth and may have lesions associated with that infection. The difference between an infected calf that was aborted due to *Neospora* and one that was aborted due to something else is the severity (number) of lesions. This is also why we hope to see lesions in other tissues in addition to the brain in order to feel comfortable with diagnosing *Neospora* as the cause. While much less common as a cause of abortion in cattle, *Toxoplasma gondii* can result in similar lesions in the fetus, and this is why PCR is suggested in addition to histopathology to confirm the diagnosis.

PCR of fetal tissues is the current method to specifically identify *Neospora* as the cause when lesions are identified histologically. However, it is the sensitivity of the test that makes some interpretation of results necessary rather than just saying it is positive or negative. A negative PCR can normally be taken as an indication that *Neospora* is not present and thus not the cause of a given abortion. It is the calves with positive PCR results that are the problem. The PCR test is so sensitive that it can detect as few as one organism in one gram of tissue. This means that a test is expected to be positive whether a calf was aborted due to *Neospora* or infected but aborted due to some other cause. It is actually the combination of a positive PCR together with identification of large numbers of lesions seen histologically that results in confident interpretation of *Neospora* as the cause of abortion.

**Summary**

The diagnostics available for *Neospora caninum* detection require an understanding of the tests as well as an understanding of the life cycle of the parasite. Serology is an excellent test for exposure to the organism and herd infection status. It is not a good test in an individual animal to diagnose *Neospora* as the cause of an abortion. Histopathology is an excellent test for detecting actual lesions in an aborted fetus but has some subjectivity in interpretation by the pathologist and obviously requires the availability of fetal brain and other
tissues. PCR is an extremely sensitive test for detection of infection but should not be used alone for determination that *Neospora* was the cause of a given abortion. The “gold standard” for diagnosis should include histopathology with appropriate lesions and confirmation of the cause with PCR. This disease is one more example of the need for good communication between the clinician and laboratory microbiologist and pathologist to appropriately interpret test results.

WSDA: The Animal Health Program is “Making Sausage”

By Dr. Amber Itle, WA State Veterinarian

Rulemaking is often described as making sausage as the process requires patience, endurance and lots of time. After a few years of hard effort, the Animal Health Program is making progress with rulemaking. Public Hearings will be held via TEAMS on May 3, 2023. Please join us if you would like to share any concerns or support. The TEAMS invite can be found on our website by clicking on the rule of interest.

Overview of proposed changes for the proposed rule changes are outlined here:

**Chapter 16-70 WAC, Animal Diseases - Reporting**
- Clarify reporting requirements for veterinarians and veterinary laboratories;
- Modify the list of reportable diseases by making the list inclusive of all diseases that are required to be reported by WSDA, the World Organisation of Animal Health (WOAH), United States Department of Agriculture (USDA), and the Washington State Department of Health (WA DOH);
- Simplify reporting times from 24 hours, 72 hours, monthly, etc., to immediate reporting for veterinarians;
- Create a new section (16-70-015) specific to reporting requirements for veterinary laboratories;
- Modify the definitions section to include:
  - Adding definitions for ‘Case”, “New, emerging or unusual animal diseases’, WOAH notifiable diseases list, ‘WOAH’, and ‘Zoonotic’
  - Removing definitions for ‘OIE notifiable disease list’, and ‘OIE’
  - Amending definitions for ‘Reportable diseases list’ and ‘Veterinary Laboratory’
- Revise language to increase clarity and readability.

**Chapter 16-80 WAC, Swine Diseases Regulated in Washington State**
- Change the title of the chapter to ‘Domestic and Feral Swine in Washington State’;
- Remove definitions for “Department”, “Director”, “Exposed”, and “Pseudorabies infected herd”;
- Update the definition of ‘Official USDA-approved identification’ to reference the January 9, 2013 version of 9 C.F.R Chapter 1, Section 71.19;
- Update hyperlinks to standards adopted in sections -006 and -008;
- Repeal sections -009 and -010;
- Clarify official USDA approved identification requirements for swine in section -045; and
- Require observations of feral swine to be reported to the Washington Invasive Species Council (WISC).

**Chapter 16-89 WAC, Sheep and Goat Diseases in Washington**
- Add the word “Individual” to the definition of Official Identification;
- Add the word “USDA” to the definition of “APHIS”;
- Repeal section 012, Quarantine;
- Combine section 015 Scrapie program standards and section 022 Scrapie identification of sheep and goats;
• Add “individual” to the official identification requirements when testing for brucellosis and tuberculosis in goats whose raw milk or raw milk products being sold; and
• Remove Q fever testing requirements for raw milk dairies.

More information about rulemaking and the complete proposed rule language are listed on our agency rulemaking site here: https://agr.wa.gov/services/rulemaking.

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**Dairy: Metritis Diagnosis**

*By Dr. Caio Figueiredo, Veterinary Medicine Extension*

Metritis is a uterine disease associated with severe detrimental impacts on productive and reproductive performance, as well as animal mortality and welfare. Although reports and studies related to metritis date back to the early 1980’s, the clinical signs that defined the disease were extremely variable. In 2006, a paper published within the journal Theriogenology proposed new definitions for uterine diseases in cattle, including metritis, endometritis, and pyometra (Sheldon et al., 2006). Currently, the most common method for metritis diagnosis in dairy cows is visual evaluation of vaginal discharge and characterization according to color, viscosity, and odor.

The 2006 article has become the most cited source for defining uterine diseases, particularly metritis, and has helped standardize further studies related to uterine diseases. However, despite improvements in case definitions for metritis, a recent review indicated that large variations related to vaginal discharge viscosity (purulent, mucopurulent, or watery) that defines metritis still exist (Garzon et al., 2022). The inconsistencies in defining metritis are not restricted to the research realm. A study that evaluated metritis diagnosis practices in 45 California dairies reported that metritis diagnosis is inconsistent across dairies as well (Espadamala et al., 2018). Although it sounds insignificant to be assertive when characterizing viscosity of vaginal discharge, many problems arise from inconsistent diagnosis of metritis in dairy herds. For instance, inconsistent diagnosis decreases the likelihood of identifying positive cases, may delay onset of antibiotic treatment (see below), and increases the amount of milk loss that is unaccounted for within the herd, potentially underestimating economic losses.

Economic models using varying levels of consistency in the diagnosis of metritis have been used to evaluate the impact of misclassification of metritis on milk production (McCarthy and Overton, 2018). In that study, the inconsistency in metritis diagnosis caused up to 330,256 kg of unaccounted milk loss (Figure 1). Unaccounted milk loss represents the underestimation of metritis impacts at the herd level and prevents the possibility of optimizing protocols without a closer look into health evaluation practices. At this point, it is clear that establishing a criteria for metritis definition based on changes in performance indicators is necessary. A recent study presented at the American Dairy Science Association conference addressed this problem (Figueiredo et al., 2022). In that study, vaginal discharge was scored into 5 different groups (1 = clear mucus/lochia, 2 = clear mucus with flecks of pus, 3 = mucopurulent with < 50% of pus, 4 = mucopurulent with ≥ 50% of pus or reddish/brownish mucous discharge not fetid, and 5 = watery, reddish/brownish, and fetid discharge; Figure 2). Reproductive performance, mortality, and milk production were compared among the 5 groups of cows. Return to estrous cyclicity by 67 days in milk (DIM) and risk of receiving a first service were reduced for cows with discharge 5 (70.7 and 85.5%) compared with 2 (80.5 and 90.1%), 3 (78.9 and 90.1%), and 4 (79.6 and 91.7%), but not 1 (79.0 and 89.3%). Although discharge was not associated with proportion of pregnant cows and pregnancy loss after first service, the proportion of cows pregnant by 300 DIM was reduced for cows with discharge 5 (65.1%) compared with 2 (70.2%), 3 (72.7%), 4 (73.9%), but similar for 1 (69.1%). Median days to pregnancy according to vaginal discharge group 1 to 5 were 118, 117, 123, 130, and 148, respectively. Proportion
of cows removed from the herd within 300 DIM was greater for cows with discharge 5 (22.1%) compared with 1 (17.2%), 2 (15.4%), 3 (13.9%), and 4 (15.3%). Risk of leaving the herd did not differ among cows with discharge 1 to 4. Milk production was different according to vaginal discharge group. Although milk production did not differ among primiparous cows, milk production for multiparous cows with discharge 5 was smaller compared with discharge 1 (-7.1 kg/d), 2 (-7.4 kg/d), 3 (-4.8 kg/d), and 4 (-3.6 kg/d) in the first 3 months of lactation. These results support the need to restrict the definition of metritis in dairy cows with vaginal discharge 5 instead of vaginal discharge 5 and 4 as previously postulated.

References


Figure 1. Second test 305-d mature-equivalent milk projection (2nd 305ME) for all cows, cows classified as no metritis recorded, mild metritis, or severe metritis for the true severity (TrS) model and misclassified in the inconsistent recording (IR) and poor recording (PR) models. Negative numbers above the mild metritis and severe metritis columns for each model represent the associated milk loss (kg) for cows with mild or severe metritis.

Figure 2. Representation of vaginal discharge characteristics according to scores.
Dairy: Metritis—To Treat, or Not to Treat, That is The Question

By Dr. Caio Figueiredo, Veterinary Medicine Extension

Metritis is a uterine disease that poses a major threat to sustainability in dairy operations, as the disease is associated with up to US$ 1.2 billion/year in economic losses to the U.S. dairy industry. Recent economic analysis estimated that each case of metritis costs on average US$510.00 (Pérez-Báez et al., 2021), and approximately 20% of the costs associated with metritis arise from antibiotic treatment. Thus, a very common question asked in meetings is: “What if we don’t treat cows with antibiotics and save the money?” In fact, this practice has been adopted across the country, as per the latest USDA report (USDA, 2014), only 52.8% of cows with metritis receive antibiotic treatment (organic dairies excluded). A recent economic analysis aimed to compare the gross profit from cows with metritis treated with ceftiofur and non-treated cows with metritis (Silva et al., 2021). That study reported that non-treated cows with metritis had an average US$250.00 reduction in gross profit compared with cows with metritis that were treated with ceftiofur. Therefore, not treating cows with metritis results in greater economic loss rather than savings.

A component that potentially drives the greater loss in profits associated with lack of antibiotic treatment is achievement of clinical cure in a timely manner. Studies have shown that when treated with antibiotics, approximately 75% of cows with metritis achieve clinical cure within 2 weeks after diagnosis (Chenault et al., 2004, McLaughlin et al., 2012, de Oliveira et al., 2020). In contrast, only 57% of non-treated cows with metritis achieve clinical cure in the same time period. A recent study evaluated the clinical implications associated with cure failure of metritis (Figueiredo et al., 2021). In that study, a greater proportion of cows that failed to cure within 2 weeks had subsequent uterine diseases compared with cows that cured (90% vs. 73%, respectively). Moreover, a greater proportion of cows that failed to cure were anovular by 67 days in milk (DIM) compared with cured cows (38% vs. 29%, respectively). Cure failure was associated with an additional 29 days to establish pregnancy compared with cured cows (163 d vs. 134 d, respectively). Lastly, cows with clinical cure failure had reduced milk production which was more severely reduced in multiparous cows (Figure 1), and increased mortality within 10 months of lactation (Cure failure = 26.3%, Cured = 17.4%). Multiple research groups are currently working to elucidate cure patterns in cows with metritis to identify risk factors and develop selective therapy strategies. A few factors, such as calving season (particularly summer), occurrence of retained fetal membranes, pyrexia at the time of metritis diagnosis (rectal temperature ≥103.1°F), and occurrence of metritis ≤5 DIM have been associated with greater likelihood of cure failure.

The advancement and implementation of precision technology in dairy herds has allowed researchers to dive deeper into the physiology of metritis and cure. For instance, studies have depicted changes in cow behavior associated with metritis and cure even before its occurrence (Figure 2; Merenda et al., 2021, Prim et al., 2022). Current data does not support the use of selective therapy strategies in dairy cows with metritis, indicating that cows with metritis should be treated with antibiotics to alleviate subsequent detrimental impacts. However, the use of selective strategies for the treatment of metritis in dairy cows is a primary goal for some uterine health and reproductive physiology researchers, and recent data has shown promising results. Research is warranted to elucidate more about metritis and cure in order to develop optimized protocols and to find practical ways to implement them in dairy herds.
Figure 1. Milk production in the first 10 months postpartum for primiparous (A) and multiparous cows (B). NoMT = cows not diagnosed with metritis postpartum; MTC = cows diagnosed with metritis that underwent clinical cure following antimicrobial therapy; MTnoC = cows diagnosed with metritis that failed to undergo clinical cure following antimicrobial therapy.

Figure 2. Association between response to metritis treatment (cured: cows without fetid, watery, and brown uterine discharge and RT ≤ 39.4 °C; non-cured – cows with fetid, watery, and brown uterine discharge and/or RT ≥ 39.5 °C) and behavior according to day relative to diagnosis (DRD). (A) Feeding time: pre-diagnosis (B) Rumination time: pre-diagnosis (C) Idle time: pre-diagnosis (D) Activity time: pre-diagnosis

References


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**WSDA: Reserve Veterinary Corps**

**By Dr. Minden L. Buswell, WSDA Reserve Veterinary Corps Coordinator**

**WHAT IS THE RESERVE VETERINARY CORPS?**

The Reserve Veterinary Corps (RVC) is a body of volunteers willing to help WSDA respond to a crisis affecting animals in our state.

Washington State has a large and robust livestock industry with more than a million head of cattle, 400 dairies, and nearly 12,000 ranches statewide. The animals handled by RVC volunteers, however, could range from large farm animals to small, household pets.

Members of the RVC commonly include veterinarians, veterinary technicians, and animal health professionals, but other skills, such as foreign language skills or experience in public health, law enforcement, incident command expert, or the military are also sought.

**WHEN IS IT USED**

The WSDA Reserve Veterinary Corps exists to provide WSDA with a ready supply of volunteers willing to assist in animal emergency response. The mission of the RVC is to assist WSDA Animal Services Division in responding to natural disasters such as wildfires or floods, an animal disease outbreak such as avian influenza, or any large-scale incident that requires caring for animals.

Members help with veterinary medical care, evacuations, sheltering, vaccinations, collecting specimens, decontamination, education and outreach, or in some cases even euthanasia and necropsies. For example, the RVC activated in April 2014 to help in the response to a devastating mudslide on State Route 530 in Snohomish County. The RVC members and WSDA veterinarians provided care and treatment for rescue dogs working at the disaster site.

**MEMBERSHIP**

Participation in the RVC is voluntary, but members should be trained on the Incident Command System, a method of organizing and managing large-scale emergency responses. The training is free and provided by WSDA.
Other RVC member trainings include:

- Foreign animal disease response
- Hazardous materials awareness
- Animal decontamination
- Emergency Animal Sheltering

On average, there are two to four training events each year. In some cases, volunteers are provided a stipend to offset travel the travel costs associated with the training.

**UPCOMING TRAINING**

In July 2023, the RVC has a unique two-day training opportunity in Richland, WA. Franklin County Emergency Management is hosting a drill practicing an Emergency Worker Assistance Center (EWAC). The exercise scenario is an airborne release of radioactive materials and workers and residents will be directed to the center to be checked for radioactive contamination, decontaminated if necessary, registered for future health monitoring, and sheltered until evacuation orders are lifted.

Animal decontamination will not be exercised, but RVC members will see how human radiological decontamination centers operate and how animal decontamination could be included and/or mirrored in a similar scenario. Prior to the main exercise, WSDA will host an animal decontamination tabletop training to discuss animal decontamination logistics in a radiological event. This lecture-based training provides RVC members with background information to best assess how animal decontamination could be incorporated into an emergency response.

**TO LEARN MORE ABOUT JOINING THE WA RVC**


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**WSDA: Recruiting Summer Interns: Help Develop Enhanced Biosecurity Plans for Beef Producers in WA!**

*By Dr. Minden L. Buswell, WSDA Reserve Veterinary Corps Coordinator*

If foot and mouth disease (FMD) is found in United States livestock, regulatory officials will limit the movement of animals and animal products to try and control the spread of this very contagious animal disease. The Secure Beef Supply (SBS) Plan for Continuity of Business provides opportunities to voluntarily prepare before an outbreak. This will better position beef premises with cattle that have no evidence of infection to:

- Limit exposure of their animals through enhanced biosecurity,
- Move animals to processing or another premises under a movement permit issued by regulatory officials, and
- Maintain business continuity for the beef industry, including producers, haulers, and packers

During an FMD outbreak, it is the producer’s responsibility to keep their animals from becoming infected through biosecurity. Biosecurity approaches are both structural and operational. Successful implementation of these practices depends on the awareness level and behavior of individuals on the feedlot during an FMD outbreak. The enhanced biosecurity recommendations outlined in the SBS are based on the known exposure routes for FMD.
Student interns will work with WSDA veterinarians, WA Beef Commission (WBC), WA Cattle Feeders Association (WCFA), and Washington Cattle Association (WCA) to identify 30-40 beef premises willing to complete the SBS - Enhanced Biosecurity Plans (EBP). Interns will then meet with WA beef producers on the premise and work with them to draft an initial plan.

The completed enhanced biosecurity plans will be supplied in-person to the beef producer in hard copy and to WSDA in electronic form for approval. The hard copy plans will consist of a binder that includes the enhanced biosecurity plan and relevant Secure Beef Supply educational material to implement the plan.

If interested in this PAID internship, contact Dr. Minden Buswell at mbuswell@agr.wa.gov or call 360-280-6499.

APPLICATION DEADLINE APRIL 30, 2023

WSDA: Equine Influenza Virus on The Rise Again in Washington

By Dr. Amber Itle, WA State Veterinarian

Horses are on the move and so are equine diseases. Just this week a quarantine was released at the polo facility where 600 horses were exposed to Equine Herpes Virus (EHV) in California. That is a good reminder to everyone of how important vaccination is to mitigate disease severity and allow for continuity of business. Now is the time to encourage your clients to get up to date on EHV, Flu/Rhino and West Nile Disease in addition to the core vaccines recommended by AAEP. This is especially critical in boarding facilities where horses come and go to shows, events and even trail rides. Any commingling event is an opportunity for viral spread. Although horses that are vaccinated can still contract the virus and spread it, the course of disease should be less severe.

In the last few weeks, WSDA is starting to see an uptick in cases of Equine Influenza Virus (EIV) in Western Washington. Equine Influenza virus is a very contagious infectious respiratory disease of horses and is a reportable disease to the State Veterinarian. In recent years, we have seen high morbidity in stables across 13 counties in the State. As soon as the attending veterinarian gets positive laboratory results, EIV must be reported through the Reportable Animal Disease database. Once reported, a field veterinarian will follow up with you to see how we can best support you. WSDA also reports to the Equine Disease Communication Center and they distribute minimal information that protects personally identifying information through an alert to subscribers. Usually, private practitioners manage individual cases of EIV by performing diagnostics, addressing individual horse treatment, implementing on farm biosecurity practices, and helping the barn manager institute a self-quarantine of infected or exposed horses.

In some cases, when morbidity is high and/or stable compliance is a problem, the State Veterinarian can be requested to assist. WSDA field veterinarians can issue quarantines in order to mitigate the spread of disease and protect horse health and the economic vitality of the equine industry across the state. A quarantine will be in place until 14-21 days after the last “new” case, allowing for a full incubation period to pass
by without clinical signs. Horses can remain contagious for 10 days after clinical signs or fever starts. The quarantine will require that rectal temperatures be recorded daily whenever possible so that febrile horses can be rapidly isolated, tested and monitored for clinical signs. Often viral infections can be “dose dependent” so rapid removal of sick horses can reduce viral load and transmission.

Airborne transmission is the most common way horses become infected. Infected horses release infective droplets into the air by coughing or snorting which are then inhaled by horses in close proximity. Horses can also be exposed to the virus by coming into contact with contaminated surfaces such as stalls, wash racks, stocks, water sources, feed, tack, grooming equipment such as wipe rags, and transport vehicles. Humans can spread the virus from horse to horse by contaminated hands and clothing, so the adoption of biosecurity measures is paramount.

WSDA Field veterinarians can also assist private practitioners with on farm biosecurity plans to help mitigate viral spread. Here are some biosecurity tips you can customize for your clients during a (self or state mandated) quarantine period to help ensure the health and welfare of your client’s horse.

1. **Observe Strict Biosecurity**
   a. Limit Stress to horses
   b. Control flies, vermin, vectors
   c. Monitor all horses’ rectal temperatures on the premises twice a day
   d. Keep hoses out of free-standing water such as ponds or creeks
   e. Promptly remove compost and manure
   f. Wash hands frequently
   g. Prevent direct contact with infected horses
   h. Do not share equipment, buckets or tack
   i. Tape off an “off limits” perimeter outside any symptomatic horse stall approximately 3 feet by six feet. Only people that need to enter the stall are permitted into this area.
   j. Place a foot bath outside the stall with disinfectant, to dip feet into prior to entering and again after exiting the stall. Be sure to clean your boots before you disinfect.
   k. Frequently clean and disinfect the stall
   l. Designate one person to care for your horse and limit contact of personal with exposed horses
   m. Notify your veterinarian immediately if you notice any clinical signs or changes in behavior. Horses with EIV are prone to secondary bacterial infections.
   n. Coughing horses aerosolize the organism and can spread the virus as far as 150 feet

2. **Horse Management**
   a. Supportive care and treatment at prescribed by your veterinarian
   b. Keep in well-ventilated stall and or paddocks to reduce inhalation of dust
   c. Consider staggering outdoor paddock access to avoid nose to nose contact
      i. Spray any common contact areas with 10% bleach.
   d. Consider physical barriers between outdoor runs to avoid nose to nose contact
   e. Keep dust down in the stall and hay (by wetting if needed)

3. **Exercise** - No sick horses should be allowed in the main arena or in shared wash racks.
   a. **Symptomatic** horses (fever, lethargy, nasal discharge, coughing, etc.)
      i. Febrile horses should remain in their stalls and allowed to rest.
      ii. Avoid strenuous exercise and hand walk or exercise lightly for short periods of time.
• Remember, your horse is not feeling well and may be lethargic, have painful muscles or a cough that can be exasperated by exercise. The idea is to stretch the horses legs and provide some stress relief from being stalled.

  iii. Lightly exercise horses in the designated round pen area away from other horses
  iv. When moving horses down the alleyway, use the closest exit and be cautious to avoid direct nose to nose contact with other horses.
  v. Only one horse should be exercised at a time and a schedule should be posted if needed.

b. **Exposed, non-clinical horses** (No fever, no nasal discharge, rare or occasional cough)

i. Avoid strenuous exercise, but light riding or exercise is acceptable.

  • Remember that your horse’s immune system may be under stress from recent exposure and fighting off potential infection. Too much exercise may exasperate clinical signs or illness.

  ii. All horses should exit the barn on the north side.
  iii. Exercise horses in the designated outdoor arena space
  iv. Only one horse should be exercised at a time and a schedule should be posted if needed.

Mapping the farm can also be helpful when thinking about horse movement patterns on the farm as well as identifying access points, parking, cleaning and disinfection stations and carcass pick up areas.

Practitioners can find this graphic on our website to be printed and provided to your clients. We also have large, printed posters available upon request.

Additional Equine Biosecurity Resources can be found on our website.

Abstract: Postmortem bacterial culture is controversial in human medicine, and veterinary-specific research in this area is lacking. To address this knowledge gap, we cultured liver, kidney, and spleen individually from on-farm calf mortalities to determine the number of bacterial species present, concordance between organ cultures, and agreement with gross and histologic findings. We hypothesized that the spleen, a filtering organ, would be the most useful organ with the least amount of postmortem contamination given that it does not have a direct conduit to a bacterial population. Fresh liver, kidney, and spleen were collected for culture from 30 calves 5-28-d-old with various causes of mortality. Bacterial growth of ≥2 species was observed in ~48% of cultures, with Escherichia coli and Streptococcus spp. being most frequent. One bacterial species was present in 20% of cultures, with E. coli predominating. No growth was observed in ~32% of cultures. In 43% of cases, there was agreement in the culture results for all 3 organs; however, the majority were mixed bacterial growth. The best agreement was observed when there were no gross and/or histologic septic lesions in target organs and no bacterial growth on culture. The spleen was not helpful in determining bacterial significance in comparison to kidney or liver.


Abstract: Less invasive rumen sampling methods, such as oro-esophageal tubing, became widely popular for exploring the rumen microbiome and metabolome. However, it remains unclear if such methods represent well the rumen contents from the rumen cannula technique. Herein, we characterized the microbiome and metabolome in the rumen content collected by an oro-esophageal tube and by rumen cannula in ten multiparous lactating Holstein cows. The 16S rRNA gene was amplified and sequenced using the Illumina MiSeq platform. Untargeted metabolome was characterized using gas chromatography of a time-of-flight mass spectrometer. Bacteroidetes, Firmicutes, and Proteobacteria were the top three most abundant phyla representing ~90% of all samples. Although the pH of oro-esophageal samples was greater than rumen cannula, we found no difference in alpha and beta-diversity among their microbiomes. The overall metabolome of oro-esophageal samples was slightly different from rumen cannula samples yet more closely related to the rumen cannula content as a whole, including its fluid and particulate fractions. Enrichment pathway analysis revealed a few differences between sampling methods, such as when evaluating unsaturated fatty acid pathways in the rumen. The results of the current study suggest that oro-esophageal sampling can be a proxy to screen the 16S rRNA rumen microbiome compared to the rumen cannula technique. The variation introduced by the 16S rRNA methodology may be mitigated by oro-esophageal sampling and the possibility of increasing experimental units for a more consistent representation of the overall microbial population. Studies should consider an under or over-representation of metabolites and specific metabolic pathways depending on the sampling method.
GUESS THAT BREED!

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