Improving the Quality of Veterinary Practice – Using Your Skills to do a Better Job for Your Patients and Clients

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Abstract

Cow health is a priority for dairy producers who look to their veterinarian to design and implement protocols, train employees to be responsive to cow health and welfare issues, and to monitor the impact of preventive and treatment interventions on productivity of the herd. Using typical dairy herd health problems as case examples, a detailed approach that incorporates individual animal evaluation and scoring, appropriate herd-based testing, observation and analysis is described. The art of observation, examination and analysis of the animals is an essential element that the veterinarian brings to innovative, creative, technologically and scientifically sophisticated approaches to improved dairy cattle health and productivity.

Introduction

Cow health continues to be a priority for dairy producers, as evidenced by the responses reported in a producer and veterinarian trend study.[2] Dairy producers reveal that herd health management, proper use of animal health products and disease diagnosis are the veterinary services they value most. While the veterinarian is valued for his knowledge and experience, he is not necessarily viewed as taking a leadership role on the dairy. Almost 40% of dairy producers expect more veterinary involvement in mastitis control, vaccination, health programs and disease diagnosis,[2] yet most routine diagnoses, vaccinations and treatments are done by farm labor. Veterinarians who fail to stay involved in the routine practices on the dairy, either by failing to institute, refine, train or monitor protocols, will lose a significant opportunity to be the dairy's leader in promoting herd health and productivity. Through the leadership of the veterinarian, protocol design, implementation and monitoring heighten awareness and responsiveness to animal health and welfare issues on the dairy. Producers expect the veterinarian to be responsive to individual animal and herd health issues. Responsiveness is defined as using basic skills (observation, examination, testing procedures), analyzing results and implementing innovative, creative, and scientifically sophisticated plans.

In this paper, typical dairy herd health problems will be used to demonstrate the critical role the veterinarian plays in health management issues of the modern dairy. Armed with some different ways to evaluate old problems, we hope there will be renewed enthusiasm that comes from the excitement of applying new knowledge, constructing new ideas and taking new directions to fix these problems.

Case Presentations

Case 1: You work with a 550-cow dairy that is having calf health problems. A wet-calf raiser picks up newborn heifer calves from the dairy after they receive a four-quart colostrum meal. The calf raiser reports diarrhea and now respiratory disease problems in calves less than one week of age. Mortality rates have been 20, 47, 17, 53, 34 and 5% in each of the last six months, respectively. In the previous 12 months, monthly calf mortality rates ranged from 5 to 58% for another calf raiser. Both the dairy producer and the calf raiser are concerned.

Despite the change from one calf raiser to another, there is a long history of disease and mortality in very young calves. There is a perception, supported by written colostrum protocols (Table 1) and testimonials from management, that the colostrum-feeding program is optimal, but you are concerned.

Failure of passive transfer is a problem that continues to have a significant negative impact on dairy calf morbidity, mortality and future productivity. You know that any conclusions regarding adequacy of colostrum feeding cannot be based solely on spoken word. Rather, observation of feeding practices and testing are needed.

While methods for testing individual calves for adequate colostrum absorption are well known to veterinarians, strategies for documenting a herd problem of failure of passive transfer (FPT) are more involved. Accurate conclusions require appropriate sample size,

Table 1. Colostrum protocol for Farm #1.

Colostrum Feeding Check List
Check maternity pen every hour. Move cow to labor pen when feet show.
When cow is moved to labor pen, begin to thaw one jug of frozen colostrum. Use frozen colostrum from Johnes ELISA and *Mycoplasma* culture-negative cows. If there is no colostrum, use 1 pack of colostrum replacement product. Add four cups of colostrum supplement to the colostrum replacer. After birth, move calf to hutch in maternity pen. Twenty minutes prior to colostrum, give calf intranasal vaccine (IBR, PI_3), Bovine Ecolizer® + C and Calf-Guard® Add two cups of colostrum supplement to thawed colostrum and give to calf. If calf won't nurse, use esophageal feeder. When colostrum is in, call calf raiser to pick up calf. Move fresh cow into the milking parlor at next milking (3X milking).

a discriminating test and an appropriate population of calves to test. Using a proportional outcome-based test, a sample size of 12 calves will give us a 75% confidence interval in the results of that test.[4] A serum protein concentration of 5.5 g/dl, as measured by refractometer, is established as the cutpoint,[5] and we are interested in the proportion of calves that fall below the cutpoint. When greater than 20% of calves fall below the cutpoint, FPT is a potential herd problem (Table 2).

Any calf that has received colostrum at least six hours prior to sampling and all calves less than seven days of age are eligible for testing. Your test results are shown in Table 3.

From these data, you conclude that FPT is a herd problem (50% of tested calves fall below the established cutpoint) and calf health and future productivity of replacement heifers may be compromised until this problem is resolved.[3,8]

After initial data collection, observation reveals several opportunities to improve acquisition of passive immunity in this dairy's calves. Several hours elapse between the birth of the calf and administration of a jug of thawed colostrum. Delays in feeding colostrum could be minimized if fresh or refrigerated colostrum were available. Several jugs of frozen colostrum are under-filled, resulting in less than the reported 1-gallon volume being given to several calves. After calving, colostrum is collected from fresh cows at the next milking time. If calving occurs at milking time, colostrum may not be collected for 10 to 12 hours after calving. A 10-12 hour delay from calving to milking may result in significant decline in the immunoglobulin concentration (quality) in colostrum.[7] Finally, mixing the colostrum supplement product with colostrum may have a negative impact on absorption of IgG_1.[6]

Table 2. Total protein testing used as an indication of failure of passive transfer in a herd.

Outcome: < 5.5 g/dl	Percentage	Interpretation
0/12	0%	No colostrum feeding problem
1/12	8.3%	No colostrum feeding problem
2/12	16.7%	Borderline concern for herd FPT
3/12	25%	Borderline concern for herd FPT
4/12	33.3%	FPT in this herd
5/12	41.7%	FPT in this herd
6/12	50%	FPT in this herd

The opportunities and importance for improvement in acquisition of colostral immunity in calves is discussed with farm management and calf feeders. A colostrum feeding record is established for the dairy so that time of calving, time of colostrum collection, time of feeding, colostrum volume, colostrum source and total protein concentration of the calf is monitored. Results are reviewed monthly and a bonus system is established for calves that test above the protein concentration cutpoint.

Case 2: Several dairy herds that you are working with complain of ear infections in young calves that are

Table 3. Total protein concentrations from 12 calves between one and six days of age.

Calf number	Total protein (g/dl)
1	5.2
2	5.0
3	7.5
4	4.9
5	6.1
6	5.9
7	4.8
8	5.1
9	4.6
10	5.5
11	5.5
12	6.2

presumed to be *Mycoplasma* infections. Affected calves, many of which have never consumed raw waste milk, are treated with several antibiotics for a long period of time and either fail to recover or go into the weaning pen as chronic poor doers. You are under pressure to develop an autogenous *Mycoplasma* vaccine to solve the problem.

The best approach to solving this and most calf health problems is to validate the diagnosis and then modify the pertinent risk factors. Ear infections (otitis media) in dairy calves are usually a manifestation of a respiratory disease problem in the pre-weaned calves. One or both ears may be affected, and the bacterial isolates from clinical cases mimic those isolated from pneumonic lungs and the nasopharynx – *Pasteurella multocida, Mannheimia haemolytica, Arcanobacterium pyogenes, Mycoplasma bovis, Mycoplasma dispar, Haemophilus somnus* and others. Mixed bacterial growth is common and the source of infection may be infected calves, contaminated milk, aerosol and/or dust. The causal organisms gain access to the middle ear either by retrograde migration from the pharynx (through the Eustachian tube), by hematogenous spread or, less likely, by extension from the external ear canal. Concurrent pneumonia in the individual calf with an ear infection or the commingled calves in the group is common. Diagnosis of a unilateral ear infection is not challenging, but the signs exhibited by calves with bilateral ear infections (head and neck extension, dropped ears, depression and recumbency) are not pathognomonic. When the inflammation in the middle ear of affected calves directly or indirectly results in demonstration of vestibular signs (ataxia, weakness, nystagmus) and facial paralysis, the prognosis for recovery is guarded.

Treatment failure is common among dairy herds with sporadic ear infections in calves. In part, poor responsiveness is due to difficulty in detecting affected calves early in the course of their disease. Symptomatic calves have chronic infections with severe inflammation, engorged or abscessed tympanic bullae and concurrent consolidating bronchopneumonia. Penetration of antibiotics into the site of infection at appropriate concentrations to treat all the bacterial isolates is difficult, and compliance with appropriate treatment duration is rare. If *Mycoplasma spp* is playing a role in the infection, there are additional challenges because of the biology and resistance of the organism.

Disappointing treatment responses make prevention the most logical approach to the herd problem. Identify which risk factors from Table 4 are relevant to your herd.

Colostral immunity is no less important for the prevention of upper and lower airway respiratory tract infections in calves than it is for diarrhea. FPT creates susceptible calves that shed organisms into the bedding and aerosol at higher rates than their immune peers. Susceptible calves that commingle with calving, sick, or lame adults, or that share air space with recently weaned calves, are at high risk of developing respiratory disease. Calf-to-calf contact escalates organism build-up in the environment, and if time between occupants of individual or group pens is short, the survival time of the respiratory pathogens is also enhanced. Warm, damp, overcrowded and poorly ventilated calf facilities create additional opportunities for organism numbers to accumulate in the aerosol. Feeding unpasteurized waste milk adds another important risk factor for *Mycoplasma bovis* respiratory problems in calves. Add vaccine stress, poor water availability and inconsistent management practices, and pneumonia and ear infections become endemic problems.

While working to reduce the risk of infection, train calf feeders to identify respiratory disease early. Unlike calves with diarrhea, most calves early in the course of respiratory disease cannot be identified by a change in appetite. Therefore, in problem herds an enhanced disease detection protocol is implemented. Calves that have a total protein concentration < 5.2 g/dl are identified by a paint stripe, modified ear tag, or pen marker. Tem-

Table 4. Identification of the risk factors that impair calf health.

Calf Risk Factor Analysis	
Failure of passive transfer of immunity	Timing of intervention – cow or calf
	Colostrum volume
	Quality of colostrum - Ig content, bacterial contamination
Overwhelming exposure to organisms	Bedding
	Aerosol
	Feed/Feeding practices
	Commingled age groups
Stressors	Management changes
	Water availability
	Medications
	Vaccinations

perature monitoring is initiated on day 3 in these susceptible calves. Temperature monitoring in the rest of the calves begins on day 7 unless more than 25% of the calves in the group are being treated, in which case it starts earlier. You train farm labor to identify calves with respiratory disease using a scoring system shown in Table 5. Treatment is started on any calf whose respiratory score is ≥ 5.

The antibiotic treatment protocol is based on nasal swab cultures obtained from a minimum of 6 or a maximum of 10% of untreated, at-risk calves. For most dairy calf respiratory disease problems, calves between 7 and 14 days of age are selected for culture. While nasal swab cultures may not accurately reflect the otitis media or pneumonia pathogens, they predict the antimicrobial susceptibility pattern of the pathogenic bacteria, and are useful predictors of the role *Mycoplasma bovis* plays in the herd problem.[1] If more than 20% of calves have *Mycoplasma bovis* in the nasal swab culture, the antibiotic protocol is revised away from cell wall-dependent antibiotic killing. The duration of therapeutic antibiotic coverage may be as short as five days when an early detection scheme is in place. Calves with pneumonia or ear infections require coverage for a minimum of 10 to 14 days. If three different antibiotic regimens of treatment have failed to resolve the respiratory problem, culling should be considered.

There is no evidence that vaccination of pre-weaned dairy calves to prevent pneumonia or ear infections has sustained efficacy over time. Testimonial evidence for the direct or indirect benefit of intranasal vaccination against infectious bovine rhinotracheitis (IBR) and parainfluenza 3 (PI_3) viruses is widespread. *Pasteurella* bacterins, though frequently used in pre-weaned calves, may have harmful side effects. Commercially available *Mycoplasma* vaccines are labeled for stocker and feedlot calves or heifers during the first pregnancy. Autogenous *Mycoplasma* vaccines, while used on many dairies, may contain many strains that are not pathogenic, do not necessarily have appropriate virulence factors and have not been successful in overcoming this organism's ability to dynamically evade the immune system. The most appropriate preventive measures for dairy calf respiratory/ear infection problems are an effective colostrum feeding program, pasteurization of waste milk or use of milk replacer, isolation of age groups, all in-all out calf housing strategies, and removal of chronically infected calves.

Case 3: You are working with a 1,000-cow Holstein herd, whose major concern is health problems in early lactating cows. In the past year, there was an 8.9% death loss (89 cows in 1,000 calvings) and temperature surveillance of cows for the first 12 days after calving shows as many as 40% of cows with rectal temperatures >103°F. *Salmonella enterica var typhimurium* was a herd problem 1-1/2 years ago, but diarrhea has not been a complaint since then. The annual herd turnover rate is 39%.

To begin this investigation, records are reviewed to validate and clarify the magnitude, nature and timing of the problem. Typical of many dairies, though, data are incomplete, disease diagnosis and reasons for cows leaving the herd are poorly defined. A review of dead cow records show that 28% died within the first 50 days in milk (DIM). The most common diagnosis among the cows that died was "sick", a term adopted for diagnosis unknown (31% of the deaths), with remaining deaths attributed to problems common to most dairies – toxic mastitis, injury, pneumonia, and others. From this information, the problem definition becomes clearer. There is a high herd mortality rate, with most of the deaths (78% in the last year) occurring after 50 DIM and due to problems typically recognized on dairies. Of most concern to owners and managers, however, are fresh cow deaths from undiagnosed illness.

Table 5. Respiratory disease scoring system.

Exam parameter	Score
Rectal temperature	0) 100-100.9°F
	1) 101-101.9
	2) 102-102.9
	3) ≥ 103
Cough	0) None (spontaneous or induced)
	1) Single cough induced
	2) Induce repeated or occasional spontaneous
	3) Repeated spontaneous coughing
Nasal discharge	0) Normal, serous
	1) Small amount or unilateral, cloudy mucus
	2) Mucus discharge in both nostrils
	3) Copious, mucopurulent nasal discharge

The fresh cow problem work-up consisted of reviews of fresh cow monitoring, the current treatment protocol (Excenel® RTU, ECP®, and Banamine® for three days if rectal temperature is ≥ 103.5°F), traffic patterns, group changes, nutrition and ration analyses that occur in the herd from dry-off through 50 DIM. We assessed the respective cow group environments, looking for the risk factors that created heightened susceptibility in this herd. The principle concerns were ketosis, fatty liver disease, hypocalcemia, hypokalemia, salmonellosis and bovine viral diarrhea virus (BVDV).

The non-esterified fatty acid concentrations in pre-fresh cows demonstrated a moderate problem with negative energy balance. In part, this was attributed to low dry matter intake associated with an inappropriately high level of anionic salts. No subclinical ketosis was found in the early lactation cows screened by blood β-hydroxybutyric acid concentration. With the exception of particle length in the total mixed rations, no substantive nutritional problem was identified. There was, however, routine administration of Cal-Dextro® No. 2 (8.42 g calcium/500 ml; 82.5 g dextrose/500 ml) to second-lactation and older cows at calving. Bulk tank milk, screened for BVDV by RNA probe, was negative. Two moribund cows, subjected to post mortem examination, grew *Salmonella muenster* from intestinal contents and liver. Culture of environmental specimens, consisting of bedding material from pre-fresh, post-fresh and hospital pens and swabs of watering surfaces (submitted in buffered peptone water pre-enrichment media), yielded heavy growth of *Salmonella muenster*. The cultures were biochemically identical and demonstrated antibiotic susceptibility to several antibiotics, including ceftiofur. Fresh cows and hospital pen cows commingle immediately after calving until milk is saleable. While fresh cow monitoring by rectal temperature was routine when cows entered the milking group, observation of the pre-fresh and immediately post-fresh cows was not optimal.

The information gathered suggests that there is significant risk of salmonellosis in calving cows in this herd. There are low feed intakes that drive early fat mobilization and a predisposition for the immune suppressing condition of fatty liver disease. Environmental exposure to *Salmonella muenster* is guaranteed in the three environments that the most susceptible cows are in (pre-fresh, hospital and post-fresh pens). By the time illness is detected in the post-fresh group, cows may have been sick and untreated for several days.

After cleaning all of the *Salmonella* positive pens to the ground, two inches of dirt was removed and a new sand base was added to the ground. In the pre-fresh pen, the bedding depth was increased to three inches, and daily addition of clean straw improved cow comfort. Surfaces around watering areas were cleaned and disinfected with an appropriate disinfectant. A separate brush was used for cleaning waterers in each different pen. The plan was to place emphasis on solving fresh cow health issues, expecting that there would be a significant carry-over effect into the later-lactation health issues. The goal of earlier disease detection was complemented by an effort to have examination of sick cows yield a more specific diagnosis, which could be recorded and reviewed at the regular herd visits.

In addition to the fresh cow temperature monitoring, health-monitoring schemes were put in place for the close-up dry cows and immediately post-fresh cows. In the latter two groups, the pens will be monitored immediately after feed delivery. Any cow that fails to come to the feed bunk within 10 minutes of feeding is pulled for further examination. An expanded cow examination scheme is implemented, using the parameters shown in Table 6.

Cows with a score >5 (abnormal in at least two categories) are treated using revised protocols for pneumonia, diarrhea, metritis, mastitis and unknown diagnosis. The routine administration of intravenous Cal-Dextro® No. 2 to second-lactation and older cows at calving was discontinued and supplanted by oral calcium administration. Commingling of fresh cows and hospital pen cows before milk was saleable was discontinued, avoiding potential *Salmonella* spp exposure. Feed refusals were re-routed to avoid close-up dry cows, hospital and recently fresh cows. Once-weekly urine pH monitoring in the pre-fresh pen was implemented, and cow trafficking issues were reviewed to reduce the number of pen moves between dry-off and 21 DIM. Goals were set to reduce death loss from the current level of almost 9% to 5%, achievement of which would save 40 cows per year, with a gross benefit of $70,000 to $80,000 per year.

Conclusions

In each of the case scenarios described, the veterinarian played a critical role in problem solving what may be viewed as a "typical" dairy herd problem. The role that the veterinarian played in improving problem definition through data collection, observation, testing and analysis was critical. Once defined, the veterinarian played a pivotal role in coordinating solutions, communicating the value of implementing changes, training farm labor to implement new approaches and practices, monitoring effects of change and following the progress of the dairies towards achievement of stated goals. The use of skills, the value of experience, discipline and persistence bring together the art and science of veterinary medicine, reinforcing the value of our career choice.

Table 6. Sick cow scoring system.

Exam parameter	Score
Rectal temperature	0) 100-100.9°F
	1) 101-101.9
	2) 102-102.9
	3) ≥ 103
Cough	0) None (spontaneous or induced)
	1) Single cough induced
	2) Induce repeated or occasional spontaneous
	3) Repeated spontaneous coughing
Nasal discharge	0) Normal, serous
	1) Small amount or unilateral, cloudy mucus
	2) Mucus discharge in both nostrils
	3) Copious, mucopurulent nasal discharge
Fecal score	0) Normal fecal consistency
	1) Slightly loose, may have mucus or blood
	2) Manure is liquid but still forms a pile
	3) Manure has consistency of water or there are pieces of tissue, blood or blood clots
Vaginal discharge	0) None or very small amount; no odor
	1) Retained placenta > 12 hours; no odor
	2) Retained placenta > 2 days, some odor
	3) RP and/or foul-smelling discharge
Udder evaluation	0) Normal
	1) Abnormal milk but quarter looks normal
	2) At least one quarter is hard and painful, but secretion looks like milk
	3) Udder very abnormal, watery milk, sick cow
Rumen contractions	0) 2-3 strong movements/min
	1) 1 contraction/min; strength is okay
	2) < 1 contraction/min (weak and infrequent)
	3) 0 contractions heard in 2 min

References

1. Bennett RH, Jasper DE: Nasal prevalence of *Mycoplasma bovis* and IHA titers in young dairy animals. *Cornell Vet* 67:361-373, 1977.
2. *Dairy Veterinary Trends: It's a Whole New Country.* Dairy Producer and Veterinarian Trends Study. Sponsored by Pharmacia & Upjohn Animal Health and Bovine Veterinarian magazine, and conducted by MarketSense, Inc. and Vance Research Services, section 1, p 8, 1999.
3. DeNise SK, Robison JD, Stott GH, *et al*: Effects of passive immunity on subsequent production in dairy heifers. *J Dairy Sci* 72:552-554, 1989.
4. Garrett EF, Pereira MN, Nordlund KV, Armentano LE, Goodger WJ, Oetzel GR: Diagnostic methods for detecting subacute ruminal acidosis in dairy cattle. *J Dairy Sci* 82:1170-1178, 1999.
5. McBeath DG, Penhale WJ, Logan EF: An examination of the influence of husbandry on the plasma immunoglobulin G absorption in calves. *Vet Rec* 88:266-270, 1971.
6. Morin DE, McCoy GC, Hurley WL: Effects of quality, quantity and timing of colostrum feeding and addition of dried colostrum supplement on immunoglobulin G1 absorption in Holstein bull calves. *J Dairy Sci* 80:747-753, 1997.
7. Stott GH, Fleenor WA, Kleese WC: Colostral immunoglobulins concentration in two fractions of first milking postpartum and five additional milkings. *J Dairy Sci* 64: 459, 1981.
8. Tyler JW, Hancock DD, Wiksie SE, *et al*: Use of serum protein concentration to predict mortality in mixed-source dairy replacement heifers. *J Vet Int Med* 12:79-83, 1998.