



## DAIRY CALF TREATMENT FOR DIARRHEA: ARE THE DRUGS WE USE EFFECTIVE?

By  
**Dr. Richard Pereira**, Training Research Fellow, Department of Population Medicine and Diagnostic Sciences, College of Veterinary Medicine, Cornell University. **Dr. Amber L. Adams Progar**, Assistant Professor/Dairy Management Specialist, Washington State University Department of Animal Sciences. **Dr. Dale A. Moore**, Clinical Professor/Director of Veterinary Medicine Extension, Washington State University Department of Animal Sciences

WSU PEER  
REVIEWED

FS254E

# Dairy Calf Treatment for Diarrhea: Are the Drugs We Use Effective?

More than 50% of deaths in pre-weaned dairy heifers in the US is attributed to diarrhea (USDA 2010). When dairy producers and calf caretakers devote their efforts towards disease prevention, they can minimize their use of drugs to treat calf diseases. As concerns about antimicrobial resistance increase, it is especially important to re-examine drug use on dairies. This publication will focus on the use of drugs to treat dairy calfhood illnesses.

Respiratory disease and diarrhea are the two most common illnesses that result in drug use in pre-weaned dairy calves. Respiratory disease is commonly caused by both viruses and bacteria and usually requires antibiotic treatment to address the bacterial component of the disease complex. Diarrhea in pre-weaned calves is more common than respiratory disease and is most commonly caused by viruses (Rota and Corona) and protozoa (such as *Cryptosporidium*) that are not killed by antibiotics. Occasionally, diarrhea can also be caused by bacteria such as *E. coli* K-99 and *Salmonella*, which require antibiotic treatment. Determining if a calf with diarrhea needs treatment with antibiotics can be challenging when relying only on loose feces as a clue. For example, calves infected with *Salmonella* or *E. coli* K-99 will typically have yellow or white loose feces; however, yellow loose feces is also caused by coronavirus infections. The purpose of this publication is to assist dairy producers and calf caretakers with treatment decisions for diarrhea in pre-weaned dairy calves.

## Consequences of Diarrhea

When a calf has diarrhea, there are several consequences:

- The calf loses fluids in the feces leading to dehydration.
- The calf loses strong cations such as sodium (Na<sup>+</sup>) that causes an imbalance of strong cations and strong anions (such as Cl<sup>-</sup>), creating metabolic acidosis (excess of acid in the body).
- The calf may develop electrolyte imbalances because of losses of electrolytes in the feces.
- The calf loses weight due to reduced appetite or not absorbing nutrients from the gut.
- There is the potential for overgrowth of gram-negative bacteria (like *E. coli*) in the small intestine.
- There is an increased chance for development of bacteremia (bacteria in the blood), particularly in calves with failure of passive transfer of immunity (those that may not have or did not receive enough quality colostrum) or calves with severe diarrhea.

Not all these consequences happen in every case of diarrhea. Some calves simply have fluid and electrolyte losses, while others may have more severe clinical signs (high fever, emaciation, etc.). In addition to the consequences of the primary infection, calves may also develop secondary infections because their immune systems were compromised during their initial illness. The actual cause of death of diarrheic calves is not always known but likely includes dehydration and bacteremia or septicemia.

## Use of Antibiotics and Antimicrobial Resistance

Why should antibiotics be reserved for special cases of diarrhea? One consequence of non-selective use of a drug during diarrhea is the effect on calf health: a potential increase in the number of days of diarrhea. A study by Berge et al. (2009) observed that calves treated with antimicrobials for any case of diarrhea had 70% more total days with diarrhea than calves treated with antimicrobials only in cases of fever or depressed attitude. This can happen because antibiotics do not affect only disease-causing bacteria; they can also kill the normal gut microbes (which may protect against unwanted bacteria) or cause overgrowth of other bacteria, including drug-resistant, disease-causing ones.

Beyond therapeutic uses of antibiotics, feeding antibiotics to dairy calves in the milk is a practice that has been and is still used by some for treatment and prevention of diarrhea in pre-weaned calves. Currently, feeding antibiotics in the milk or milk replacer is restricted to the first two weeks of life in the US. However, this practice can result in an increased selection of drug-resistant bacteria and more days of diarrhea (Berge et al. 2009; Pereira et al. 2014) and the actual effectiveness of in-feed antibiotics for calves is questionable.

A recent review of all the labeled drugs for prevention and treatment of diarrhea in calves revealed that none had consistently been shown fully effective (Smith 2015). Because of that, treatment of calves with diarrhea is allowable if drugs are used in a legal extralabel manner (see the What is Extralabel Drug Use? sidebar). All dairy producers are highly encouraged to participate in a veterinarian-client-patient relationship to ensure calf treatment plans are effective and follow legal regulations. According to the Animal Medicinal Drug Use Clarification Act (AMDUCA), extralabel drug use in animals means the actual or intended use of a drug in an animal in a manner not in accordance with the approved labeling.

## AMDUCA: WHAT IS EXTRALABEL DRUG USE?

- Use in species not listed on the label
- Use for indications (disease or other conditions) not listed on the label
- Use at dose, frequency, or route of administration other than those on the label, and deviation from labeled withdrawal
- Any extralabel use of an approved drug must be prescribed by a veterinarian within the context of a veterinarian-client-patient relationship (VCPR)

Extralabel use of drugs should be avoided if possible because (1) it can increase selection pressure for resistant bacteria on the farm, (2) it may be illegal (depending upon which drug; for example, enrofloxacin is not approved for extralabel use in cattle), and (3) it may not result in a quicker cure. Extralabel use of drugs is limited in feeds. For some drugs such as ceftiofur (a third generation cephalosporin antibiotic), the Food and Drug Administration has restricted extralabel use conditions, which must be considered: “Veterinarians will still be able to use or prescribe cephalosporins for limited extralabel use in cattle ... as long as they follow the dose, frequency, duration, and route of administration that is on the label” (FDA 2012).

Due to potential disadvantages, use of antibiotics to treat diarrhea must be limited to targeted use. Based on a review of the literature (Constable 2004), calves with diarrhea that have systemic signs of illness (poor appetite, dehydration, lethargy or fever) or have blood in the feces have an increased risk of bacteremia (bacteria in the blood) and need antibiotic treatment. In these cases, administration of broad-spectrum beta-lactam antimicrobials (ceftiofur, amoxicillin, or ampicillin) is recommended. Developing skills to interpret the severity of diarrhea in calves and choosing the most appropriate intervention is vital to improve treatment effectiveness.

Overall, indiscriminate use of antibiotics to treat diarrhea in calves can result in increased expenses with drug treatment, extend the length of disease, and produce selection of bacteria resistant to multiple drugs, including antibiotics important in human medicine. Selection of multidrug-resistant bacteria, including non-pathogenic bacteria such as *E. coli*, can spread resistance to other bacteria on the farm and potentially increase the risk of drug-resistant infections.

## What Should Calf Treaters Look For?

### *Understanding Healthy Calf Behavior*

Maintaining calf health records and monitoring calves on a daily basis helps calf treaters detect changes in calf behavior and provide treatment sooner. How does a healthy calf spend its day? Before you can determine whether a calf is exhibiting abnormal behavior, it is important to understand how the average healthy calf would allocate its time each day (also known as a time budget). During its first six weeks of life, a healthy calf will spend 75% of its time each day lying and only about 4% of its time eating (Figure 1; Panivivat et al. 2004).

The take-away message: don’t ignore a calf that is exhibiting “normal” behavior for an abnormal amount of time. For example, both calves below (Figure 2) were diagnosed with diarrhea but exhibited different behaviors. The calf on the left spent more time standing and was very alert to the presence of humans, while the calf on the right spent more time lying and was not alert to the presence of humans.

Subtle behavioral differences, such as resting position, may also help caretakers identify sick calves. A healthy calf will typically rest in a curled-up position with its head facing backwards as it lies its head along its body. Pay attention to any calf that rests with its head facing forward and atop the bedding in front of its body (Moran 2012). Healthy calves should be easily aroused, especially during feeding time, and will stretch when they stand after a prolonged rest. Calf attitude is usually the first behavior evaluated to identify sick

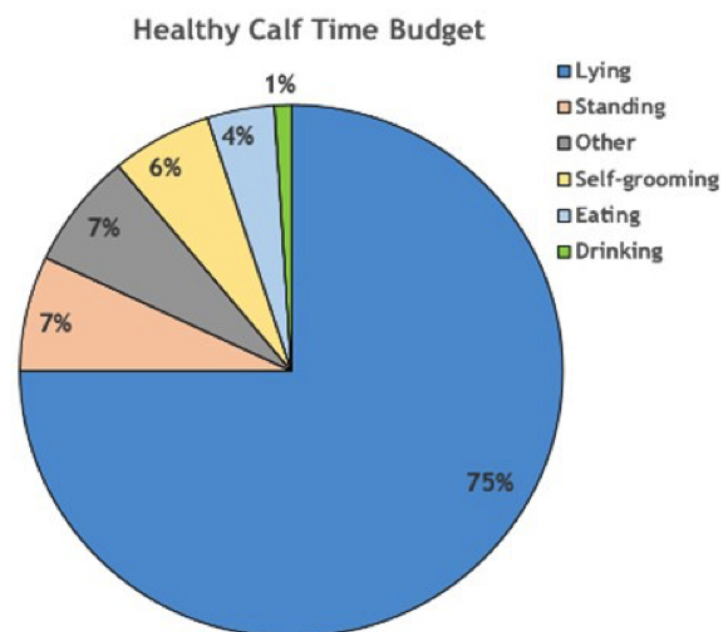


Figure 1. The percentage of time a healthy calf spends performing each behavior (lying, standing, self-grooming, eating, drinking, other) during a day.



Figure 2. Picture of two calves diagnosed with diarrhea. Each calf exhibits illness differently.

calves and is categorized as either alert (normal) or depressed (abnormal). A depressed calf lacks interest in its environment (including humans), is slow to stand and eat (or refuses to eat), has a decreased milk drinking speed, walks with a lowered head, and may have lowered (droopy) ears. Each calf responds differently to illness, so keep in mind that a sick calf may not exhibit all the behaviors associated with sickness.

### When to start treatment

Early diagnosis and treatment of calves with diarrhea is vital for improving outcomes and reducing the need for antibiotics. A scoring system such as shown in Table 1 can be used to assess the severity of clinical signs and determine treatment needs. Steps to ascertain how sick a calf is include asking the following questions:

1. Can the calf stand? What is its attitude (Is the calf suckling? Looks “bright and alert”)?
  - If the calf can’t stand and does not have a good suckle reflex, it is probably severely dehydrated and may be septic. This animal needs urgent treatment and examination by a veterinarian is highly recommended.
  - If the calf can stand, its attitude and dehydration status will help determine how aggressive the treatment should be.
2. What is the calf’s hydration status?
  - Hydration status can be assessed by gently rolling down the calf’s bottom eye lid: the bigger the gap between the eyelid and the eyeball (i.e., the more the globe is “sunken” into the head), the more severe the dehydration. Under normal conditions, the eye should be right against the bottom eyelid.

- The skin pinch test can also be used: pinch the calf’s skin to form a “tent”. If the calf is normal, the skin tent will quickly go back into place. If the calf is dehydrated, the skin tent will stay elevated and take a longer time to return to normal.

3. What do the feces look like?
  - The more watery the diarrhea, the greater the amount of liquids and electrolytes being lost or not absorbed.
  - Specific fecal characteristics (presence of blood, color, foaminess, undigested feed, etc.) may indicate specific disease processes at work.
4. Does the calf have systemic signs of a bacterial infection (or septicemia)?
  - Fever (rectal temperatures above 103–103.5°F)
  - Blood observed in the feces
  - Enlarged or swollen joints or navel

Table 1. Health scoring system for clinical signs of diarrhea in calves.

Health status	Clinical signs	Score
Fecal	Formed	0
	Semi-formed/soft	1
	Runny	2
	Watery	3
	Runny/watery with fecal blood	4
Hydration	Normal appearance	0
	Sunken eyes	1
	Skin tented 5–10 seconds	2
	Skin tented >10 seconds	3
Attitude	Alert	0
	Depressed	1

Regardless of the microbe causing the diarrhea, the first and most important steps in treating cases of calf diarrhea are:

1. ALWAYS treat the dehydration first. See Smith and Berchtold (2014) for specifics.
  - o Calves should always have access to water. If a calf is standing and has a good suckle reflex, oral electrolytes are recommended and, if correctly chosen and administered, will correct metabolic acidosis and electrolyte imbalance while keeping the abomasum pH low. Oral electrolytes should be given one to three times a day as needed.
  - o If a calf cannot stand and is severely dehydrated, intravenous fluids are needed and should be administered by a veterinarian or trained personnel.
2. Calves presenting any of the clinical signs for systemic infections or septicemia are good candidates for using antibiotics to prevent or treat bacteremia and overgrowth of *coli* in the gut.
3. Animals with fever may also be treated with anti-inflammatories such as flunixin meglumine or meloxicam. This can help improve appetite and suckling reflex.

## How to Measure Treatment Success

Although diarrhea can be evaluated using fecal scoring, improvement in fecal consistency is not a reliable guide to whether calves are hydrated and does not accurately reflect daily loss of water or electrolytes (Brooks et al. 1996). Fecal

volume now does not reflect what is currently going on in the calf’s small intestine. Rehydration and correction of acidosis must focus on other clinical signs.

Measuring a successful outcome for treatment of diarrhea will vary according to the initial severity of clinical signs. Assessing dehydration through eye position or skin tent are good methods to evaluate improvement of rehydration therapy. For severe cases, improvement in attitude (standing and suckling) will help determine if antibiotic treatment is working or is necessary. In addition, monitoring calf temperature helps evaluate treatment response in cases with bacteremia and can help indicate if treatment with anti-inflammatories should be initiated or extended.

Have a veterinarian examine any calves in which no improvement is observed within two to three days. If clinical signs increase in severity and the animal’s condition deteriorates, have a veterinarian examine the animal sooner.

## Example of Treatment Considerations for a Calf with Diarrhea

Teaching new calf treaters may be easiest with use of a flow diagram (Figure 3). The following observations may be useful when explaining a procedure for evaluating calves for diarrhea. The very first observation might be that a calf did not finish its milk or milk replacer feeding. From that point, the calf treater might look at the feces and then the attitude of the calf and follow the flow chart below.

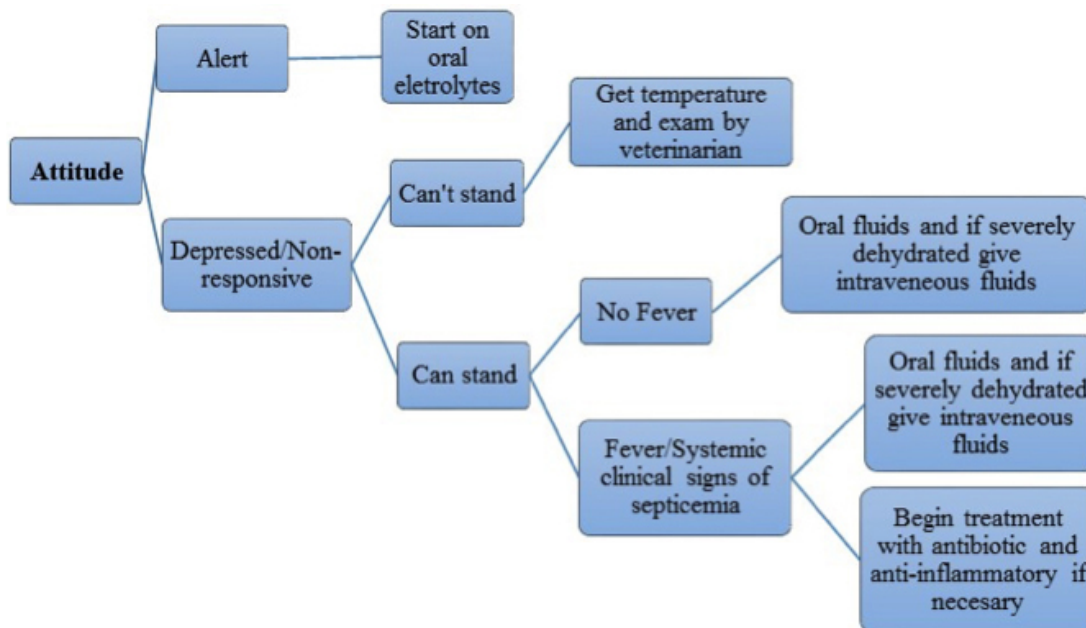


Figure 3. Decision-making flowchart to determine treatment for calves with diarrhea.

Specific, written treatment protocols are needed to address each treatment decision. These protocols should be written and understood by every member of the calf health care team. Availability of protocols to calf treaters is an important tool to avoid unnecessary or extralabel use of antibiotics.

## Prevention

Some tips for preventing diarrhea in calves require attention to cleanliness and provision of housing with adequate bedding and protection from the elements, resulting in a healthy and comfortable environment. Providing appropriate housing is one of many management strategies that contribute to healthy calves. For example, the decision to manage either an open herd or closed herd impacts calf health. In a study of calves and *Salmonella* shedding, Berge et al. (2006) found that calves housed in an open herd were over three times more likely to shed *Salmonella* than those in a closed herd.

A vital practice to increase resilience of pre-weaned dairy calves to disease is to feed newborn calves three to four liters (1 liter = 1.06 quarts) of good quality colostrum (>60g of IgG/liter and <100,000 cfu/ml Total Plate Count bacteria) within four hours of birth. This will improve absorption of antibodies from colostrum and promote a strong immune system. Failure of passive transfer of immunity through colostrum immunoglobulins puts calves at an increased risk for clinical disease.

## Conclusions

Prevention is still the best approach to reduce occurrence of diarrhea and avoid unnecessary use of drugs. Monitoring and early diagnostics and treatment of diarrhea in calves is a key point to improve outcomes. Targeted use of antibiotics for treatment of diarrhea can reduce expenses with drug treatment, reduce length of disease, and decrease the risk of selecting multidrug-resistant bacteria. Targeted antibiotic use will also help extend the functional life of antibiotics on the farm and those used for human health.

## Acknowledgements

The research and outreach for this WSU-Cornell project were supported by the Agriculture and Food Research Initiative Competitive Grant no. 2010-51110-21131 from the USDA National Institute of Food and Agriculture.

## References

- Berge, A.C.B., D.A. Moore, and W.M. Sischo. 2006. Field Trial Evaluating the Influence of Prophylactic and Therapeutic Antimicrobial Administration on Antimicrobial Resistance of Fecal *Escherichia coli* in Dairy Calves. *Applied Environmental Microbiology* 72: 3872–3878.
- Berge, A.C.B., D.A. Moore, T.E. Besser, and W.M. Sischo. 2009. Targeting Therapy to Minimize Antimicrobial Use in Preweaned Calves: Effects on Health, Growth, and Treatment Costs. *Journal of Dairy Science* 92: 4707–4714.
- Brooks, H.W., A.R. Michell, A.J. Wagstaff, and D.G. White. 1996. Fallibility of Fecal Consistency as a Criterion of Success in the Evaluation Oral Fluid Therapy for Calf Diarrhea. *British Veterinary Journal* 152: 75–81.
- Constable, P. 2004. Antimicrobial Use in the Treatment of Calf Diarrhea. *Journal of Veterinary Internal Medicine* 18: 8–17.
- FDA (US Food and Drug Administration). 2012. [FDA to Protect Important Class of Antimicrobial Drugs for Treating Human Illness.](#)
- Moran, J.B. 2012. [Rearing Young Stock on Tropical Dairy Farms in Asia.](#) CSIRO Publications: Melbourne, Australia.
- Panivivat, R., E.B. Kegley, J.A. Pennington, D.W. Kellogg, and S.L. Krumpelman. 2004. Growth Performance and Health of Dairy Calves Bedded with Different Types of Materials. *Journal of Dairy Science* 87: 3736–3745.
- Pereira, R.V., J.D. Siler, J.C. Ng, M.A. Davis, Y.T. Grohn, and L.D. Warnick. 2014. Effect of On-Farm Use of Antimicrobial Drugs on Resistance in Fecal *Escherichia coli* of Preweaned Dairy Calves. *Journal of Dairy Science* 97: 7644–7654.
- Smith, G.W., and J. Berchtold. 2014. Fluid Therapy in Calves. *Veterinary Clinics: Food Animal Practice Journal* 30: 409–427.
- Smith, G.W. 2015. Antimicrobial Decision Making for Enteric Diseases of Cattle. *Veterinary Clinics: Food Animal Practice Journal* 31: 47–60.
- USDA. 2010. [Dairy 2007: Heifer Calf Health and Management Practices on U.S. Dairy Operations.](#)



When medicating animals, you must use over-the-counter medications and products exactly as instructed on the label and follow all instructions on how long to withhold meat and milk produced from treated animals for human consumption after treatment. If your veterinarian determines it is necessary for your animal's health that you give a non-approved product or a different dose of an approved product, it is legal as long as you follow specific requirements from the FDA, including having a valid veterinarian-client-patient relationship, following the veterinarian's recommendations exactly and keeping detailed and accurate records of the animal's identity, medication used as well as its lot number, dose administered, administration route, person who administered the dose, date and meat and milk withholding times; keep such records for at least three years. Your veterinarian will tell you how long to withhold meat and milk produced from the treated animal after medication is administered.

Copyright 2017 Washington State University

WSU Extension bulletins contain material written and produced for public distribution. Alternate formats of our educational materials are available upon request for persons with disabilities. Please contact Washington State University Extension for more information.

Issued by Washington State University Extension and the U.S. Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Extension programs and policies are consistent with federal and state laws and regulations on nondiscrimination regarding race, sex, religion, age, color, creed, and national or ethnic origin; physical, mental, or sensory disability; marital status or sexual orientation; and status as a Vietnam-era or disabled veteran. Evidence of noncompliance may be reported through your local WSU Extension office. Trade names have been used to simplify information; no endorsement is intended. Published April 2017.