

# Health Management of U.S. Dairy Cattle

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There are approximately 9 million dairy cows in the United States. The number of dairy cows and dairy farms has declined steadily during the twentieth century, while milk yield per cow has increased. In 1995 about 40% of the cows in the country were located in the traditional dairy states of Michigan, Minnesota, New York, Pennsylvania, and Wisconsin, where the average herd size was 59 cows. About 30% of the cows were in the Western states, with an average herd size of 312. In the last two years herd and cow numbers in the Upper Midwest have been declining, while most of the western states except Texas have been expanding their cow numbers. There is a slow trend toward consolidation and increasing herd size nationwide. The average herd size in the US was 110 in 1995 and it is estimated that about half the cows are in herds of less than 100 cows.

Most dairy farms contain two populations of animals, the milking herd and the replacement herd. These are generally about equal in number. The milking herd includes the lactating cows and the dry cows. The replacement herd consists of growing heifers from newborns to calving. A heifer enters the milking herd she gives birth to her first calf, at 22-30 months of age. Some dairy producers choose not to raise their own replacements. They may contract with a specialized calf raiser or simply buy replacement heifers on the open market. Heifer growers may be far from the farms where the heifers will be milked. For example, Southern California dairy producers have for years used heifer growers in Central California, Idaho, Utah, and other areas where feed and land are cheaper.

Milk is of course the main food product dairy farms produce and their main revenue source. Almost all milk is pasteurized before it is sold, although dairy families and their employees may consume raw milk. There are also a small number of processors who sell unpasteurized milk commercially, generally from herds with high standards for milk hygiene. On the average 30-40% of dairy cows are culled each year. Beef from culled dairy cows is generally used in ground or processed meat products. A certain number of younger animals, generally heifers that fail to get pregnant, also enter the beef market. Most bull calves are sold. These may be slaughtered at a few days of age (bob veal), or be fed for slaughter later. Some will be fed on milk-based liquid feed as veal calves, while others may be fed in more conventional ways as dairy beef.

Many dairy producers depend only on their home-raised heifers for replacements. Others depend on auction markets or dealers to provide cattle. Dairy heifers move freely interstate, and for years there has been a net flow of heifers from the Midwest to the expanding dairy areas of the West and Southeast. These heifers are subject to regulations to prevent the spread of cattle diseases such as brucellosis, tuberculosis, anaplasmosis, and scabies, but there are generally no testing requirements for other potentially food-borne pathogens. Replacement heifers may be assembled by a dealer in a Midwestern state from several farms of origin, commingled in his facility, then transported to another sales facility closer to the buyers, and sold either individually or in groups. Dairy producers also may purchase cattle at dispersal sales, shows, and special auctions. None of the dairy producers with whom I have worked have had effective isolation procedures for purchased cattle. However many producers rely only on home-raised replacements and refuse to purchase animals. This is easily feasible on well-managed farms with acceptable culling rates and low death loss among replacement heifers. In fact, a well-managed dairy should generate surplus heifers to sell, unless it is in an expansion phase.

The modern dairy cow is a metabolic athlete. At her peak of feed intake and milk production she will be consuming about four times the calories needed for maintenance. She must make the transition from consuming 1.5 times her maintenance energy level in the late dry period to four times maintenance in about 90 days. Since she absorbs feed energy in the form of volatile fatty acids, her liver must produce all of the glucose required to make lactose and sustain life. Since her feed intake lags her nutrient requirements for production, she must mobilize body fat reserves. She must be fed a concentrated diet that will meet the protein and energy requirements for high milk yield that still allows adequate fiber intake to maintain a healthy population of fiber-digesting bacteria in the rumen. Much of the effort of dairy management consists of easing the transition of the cow from the dry period to peak production, and the prevention and treatment of conditions that arise during that period. To a large extent, the well-being of the periparturient cow depends on nutritional management of body condition gain and loss, providing adequate fiber, energy and protein in diets, and balancing vitamins and minerals correctly.

The common diseases affecting dairy cows are mastitis, metritis, milk fever, ketosis, displaced abomasum, digestive upsets related to rumen acidosis, and lameness caused by digital dermatitis (hairy foot warts) or laminitis. The dairy cow is at greatest risk of illness during the period just after calving. During this time the high-producing cow is generally in negative energy balance and is mobilizing body fat to meet her body needs. The transition from the high-fiber dry period

diet to the high-concentrate lactating diet may cause digestive upsets that cause the cow to go off feed and exacerbate the negative energy balance. Any drop in feed intake can cause the cow to mobilize extra body fat and increase the risk of ketosis and fatty liver. The uterus is undergoing rapid involution and periparturient contamination of the uterus or birth canal or retained placenta can cause metritis. Toxins released by the bacteria causing metritis can cause anorexia and exacerbate negative energy balance. Any condition that causes a cow to go off feed predisposes her to getting a displaced abomasum, which must be corrected surgically.

The early lactation cow is at risk for infectious diseases such as salmonellosis, mastitis, or metritis in part because her immune system is impaired. The ability of neutrophils to ingest and kill bacteria, the ability of lymphocytes to produce antibodies, and blood concentrations of immunoglobulin and complement have all been shown to decrease in the periparturient cow. This may be related to the dramatic rise in estrogen levels just prior to parturition.

Prevention of metritis in dairy cows entails providing proper dry period diets to prevent retained placenta, easing environmental stresses which can lead to early calving, which in turn predisposes to retained placenta, and providing clean surroundings for calving and good sanitation before obstetrical assistance is given. Metritis during the first two weeks of lactation can cause severe illness and even death. It is generally treated with some combination of intrauterine and/or systemic antibiotics or disinfectants, anti-inflammatory drugs, estrogen, and prostaglandin. Tetracycline is probably the most commonly used intrauterine antibiotic, and ceftiofur and penicillin the most commonly used systemic ones. There is no antimicrobial labeled for metritis in dairy cattle.

Mastitis is the most costly infectious disease of dairy cattle and the most common reason for antibiotic administration. There are two broad classes of mastitis pathogens. One group, all gram-positive, are contagious and are spread from cow to cow during milking. The environmental pathogens are generally found in cow manure and contaminate the udder between milkings. It is thought that the environmental pathogens are also introduced into the teats during milking, since between milking the healthy teat end provides an effective barrier to the passage of bacteria. The environmental pathogens include mainly the coliforms and the environmental streptococci. Some environmental organisms can become contagious if they infect enough udders in a herd and errors in management allow it. Prevention of mastitis involves pre and post

milking teat disinfection, milking machine maintenance, management of the cow's environment to keep udders clean and dry, milking hygiene, and dry cow therapy.

Antibiotic therapy of clinical mastitis in lactating cows is controversial, but most dairy farmers use it. In field surveys of clinical mastitis, about a quarter to a third of cases have no bacteria isolated from pretreatment samples. It is hard to justify antibiotic treatment of these cows. The available research evidence is not conclusive but most of it seems to show fairly clearly that antibiotic therapy of gram-negative mastitis makes no difference in the outcome. Many dairymen and veterinarians, however, still proceed on the assumption that it does, or give systemic antibiotics to prevent secondary infections and bacteremia. Some gram-positive organisms, such as *Staphylococcus aureus* and some of the environmental streptococci, are very resistant to antibiotic therapy. Most of the commercial lactating cow mastitis tubes were tested against subclinical infections with gram-positive organisms and are labeled for use against staphylococci and streptococci. Only one tube has a label claim for coliform mastitis and only one has been tested against clinical mastitis under field conditions.

Preventive intramammary mastitis therapy is widely used; all the commercially available tubes contain beta-lactam antibiotics; one also contains dihydrostreptomycin.

Unfortunately many veterinarians still compound and dispense their own antibiotic mixtures for mastitis therapy.

Much antimicrobial therapy in adult cows is local: mastitis tubes, uterine infusions, and topical application of antibiotics to lesions of papillomatous digital dermatitis (footwarts). However systemic therapy is often used as an adjunct. Certain conditions, such as diarrhea caused by infection agents, foot rot, and respiratory disease, are treated only with systemic antimicrobials. Because of the intense surveillance of milk and meat for antibiotic residues, ceftiofur is commonly used because it has no meat or milk withdrawal time. Penicillin, ampicillin, and sulfadimethoxine are also labeled for systemic use in lactating cows. Penicillin is often used at an extra-label dosage. Oxytetracycline is still used systemically, even though it is extra-label. There are few legitimate indications for systemic antibiotic use in adult cows, and I consider it unlikely that any new systemic antibiotics will be approved for lactating cows. Dairy cows are large animals, making systemic therapy with a new drug expensive. The long life cycle of the dairy

cow and the issue of milk residues make clinical studies in dairy cattle very expensive. The dairy market is small compared to the beef market and is steadily shrinking.

On large dairy farms most treatments are carried out by dairy employees. Employees may or may not follow protocols laid down by a veterinarian. One of the important roles of the veterinarian on large farms is to train the hospital crew use drugs rationally. One of the most important principles is to determine beforehand if the cow is indeed worth treating before committing to an extended withdrawal period. Another is to do a brief physical to determine whether the cow has an incurable condition like pericarditis or cancer and to determine the site of the infection. It is important to discourage giving systemic antibiotics just because a cow doesn't feel well without having a therapeutic goal in mind. Even on small dairy farms, most mastitis therapy is carried out by dairy employees.

There are currently no antimicrobials labeled for inclusion in lactating cow feed.

The challenge to calves begins at birth, since calves are born with no maternal immunity and are totally dependent on colostrum for immunoglobulin and fat-soluble vitamins. If the calf is born in a dirty environment, large numbers of bacteria may be ingested before the colostrum. Dairy cows are poor mothers and human intervention is essential to get an adequate quantity of colostrum into the calves in time. Colostrum must be handled properly to prevent bacterial growth and ensure that the first feeding is of true colostrum, not transitional milk, which is lower in immunoglobulin. Dairy calves are generally housed in individual hutches or crates to help prevent the spread of enteric pathogens. These are generally kept outside. Because there is a constant flow of heifer calves on a dairy farm, it is difficult to design an all-in-all-out system, and enclosed group calf housing is generally a more difficult environment in which to keep calves healthy than individual hutches outside.

The basics of disease prevention in calves for the first month of life are to practice strict sanitation of liquid feed and feeding equipment, to provide adequate shelter from the elements, to provide adequate calories for maintenance and growth, to encourage early consumption of grain and water to encourage rumen development, and to observe calves closely and treat sick ones promptly. Many dairy producers use waste milk or "hospital" milk for their calves. This is generally transitional milk from fresh cows in the first day or two of lactation combined with milk from mastitis cows and other cows whose milk may not be sold for human consumption because

they have been treated. If not handled properly, transitional milk can harbor large concentrations of bacteria and contribute to calf illnesses. The question has been raised whether the antibiotic residues in hospital milk might contribute to the development of resistant strains. On the other hand, milk replacer is generally inferior to cow's milk in nutrient content and digestibility. A common error in calf raising, especially in winter, is to underfeed calories so that the calf does not gain and does not have adequate nutrients to fight infection.

Most calf disease in the first month of life is enteric. The need for rehydration is widely recognized and oral electrolyte solutions are widely used. While academics may agree that antibiotic therapy is not necessary for many calf diarrheas, calf raisers have a strong tendency to use it. One reason for this is that it is difficult to tell in the early course of the disease whether it will become a bacteremia or not. Raisers of veal calves and dairy beef, especially, tend to be aggressive with antibiotics because so many bull calves are colostrum deprived when they are purchased. While there are several antimicrobials that are labeled for enteritis in calves, there is also quite a bit of extra-label treatment. Many milk replacers contain approved antimicrobials.

After the first month of life, most calf disease is respiratory disease. Weaning must be managed carefully to reduce the risk of pneumonia. Weaning involves cessation of liquid feeding and the introduction of the young calf to life in a group. Generally we recommend that milk feeding be discontinued before calves are to be removed from the hutches and after calves are consuming an adequate amount of grain. It is important that calves be weaned into small uniform groups to reduce the effect of competition from bigger, stronger, more experienced calves. Young calves must be taught to eat from manger, and where the water is. Housing of weaned calves must provide for small uniform groups and adequate shelter from the elements. It is essential that a coccidiostat be fed to calves after weaning. Ionophores are commonly used in the diets of growing heifers to suppress coccidia and improve feed efficiency. Antimicrobial feed additives are not used widely in growing calves, although chlortetracycline-sulfamethazine crumbles may be used to help get them through stressful times.

Dairy personnel carry out almost all treatment of sick calves, often with limited veterinary involvement or management supervision.

Biologicals commonly used to aid in the prevention of disease in dairy cattle include bacterins for *Brucella abortus*, *Leptospira spp.*, and clostridial diseases. In recent years subunit vaccines to

aid in the prevention of Gram-negative mastitis have found wide use. Live or killed vaccines for the respiratory viruses are widely used.

*Salmonella dublin* is the host-adapted strain in dairy cattle. Asymptomatic carriers may shed it in milk and feces. Contaminated milk and feeding equipment can transmit it to calves, where *Salmonella* outbreaks can be devastating. In adult cows the disease generally is manifested as a severe systemic illness, including a high fever, bloody diarrhea, dehydration, and often death, following a stress such as calving or surgery. Many strains of *Salmonella* have been isolated from such cows. Feeds may be contaminated with the organism in the field, or in storage. Feed on dairy farms is often stored in open piles, so contamination by rodents and birds can easily occur. Many large dairy farms use manure pit water to flush alleys and in California dried manure is used for freestall bedding. Eradication of the organism from these farms would be extremely challenging, although a blood test does exist that can be used to identify carriers.

Dairy cattle live in a world that is full of microbial challenges. One of the aim of sound dairy management is to limit the contamination of the food supply with these microbes, for example, by ensuring that udders and teats are clean and dry at milking time. There is such strong regulatory pressure on dairy producers that antibiotic contamination of meat and milk has become insignificant.

It is my opinion that programs aimed at eradication of specific pathogens are doomed to fail. The number of carrier cows is often very small, meaning that most of the positives that are found in a testing program will be false positives. Dairy animals commonly move from farm to farm and are often commingled on the way. Once one organism is eliminated, another will fill its niche. It is far more fruitful (and profitable for the dairy producer) to focus instead on the health, vigor, and immune competence of the animals on the farm. Improvements in feeding, housing, and management that allow cows to express their genetic potential to produce efficiently will also result in strong, vigorous animals that will resist most bacterial challenges and reduce the need for antimicrobial use.