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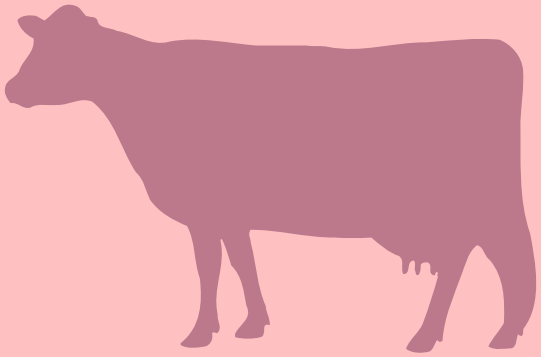
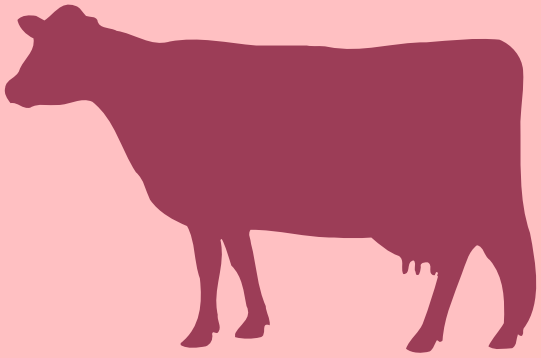
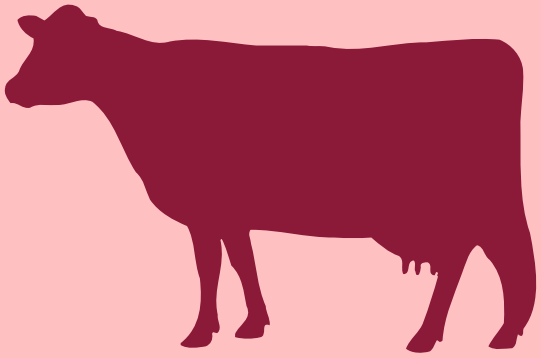




DAIRY CARE PRACTICES



Dairy Workgroup
University of California ◆ Cooperative Extension

FOREWORD

Dairy Care Practices is one in a series of University of California publications addressing the issue of animal care relating to food production in California. This revised publication is a joint project of University of California Cooperative Extension, dairy industry representatives, and members of the Dairy Workgroup.

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INTRODUCTION

Proper animal care has evolved from research and decades of practical experience. Researchers continue to investigate and enhance animal care methods. The care and management of dairy cows depends on age, location, lactation and pregnancy status, facilities, environment, health, nutrition, and many other factors. The young calf has different needs for basic care than the dry or lactating cow. Thus, managers must be aware of individual animal needs and provide for them. Proper care practices which provide for animal well-being also may be the most efficient in terms of production. If certain management practices conflict with animal well-being, it will be to the producer's long-term advantage to adopt practices that put animal welfare ahead of short-term savings.

The goals of this publication are to explain why, when, and how specific practices are used in dairy production systems in California to support animal well-being and not to set forth or suggest specific guidelines for production practices. This publication will help producers to evaluate husbandry procedures and offer production practices that are safe, ethical, and cost efficient. Variations from suggested care practices in this publication are acceptable. Continued research is essential to provide additional information about the basic needs of dairy cattle under different management systems. As new, scientifically based techniques and practices become available, management should adopt these methods to existing systems.

This publication includes a description of the dairy industry in California which documents several of the industry's unique characteristics. This is followed by **Management Components** with sections addressing specific phases of dairy production. Each section describes appropriate facilities, nutrition, and health care practices. A **Glossary**, **Bibliography**, and **Index** are included to assist the reader with terminology and sources of additional information.

THE DAIRY INDUSTRY IN CALIFORNIA

California's dairy industry is influenced by two key factors. First, California's geographical isolation substantially limits the amount of fluid milk that can flow into or out of the state. The Sierra Nevada Mountains and the unpopulated desert to the east of California, and the Pacific Ocean to the west, present geographical barriers to low-cost transportation of milk. Therefore, the California dairy industry has to produce enough fluid milk to meet the demands of the state's more than 30 million residents. The second factor influencing the California dairy industry is its unique pricing system. Price is determined by a complex set of stabilization, marketing, and pooling plans. This system is quite different from the federal milk marketing orders that affect milk price in most of the U.S.

California dairying also differs substantially from typical dairying areas in the East and Midwest. Drylot dairy farming was developed in Southern California in the 1920s and 1930s because of expensive land, and it predominates today. Dairy producers can milk 500 to 800 cows on a land area as small as 100 acres by housing cows in a drylot, handling waste properly, and purchasing all their feed ingredients. This allows for a more intensive system of milk production than traditional pasture-based systems.

California cow numbers have increased about 2 percent per year in recent decades. Milk cows now account for about 12 percent of total cow numbers in the U.S., compared with less than 5 percent in 1960. Average herd size in California is approximately 650 milk cows, compared with a national average of 60 milk cows.

Average milk production per cow in California is also one of the highest in the U.S. (along with Washington and New Mexico). In 1996, average milk production per cow exceeded 20,000 pounds compared with the national average of just over 15,000 pounds.

In 1996, California's 2,200 dairies marketed nearly 22 billion pounds of milk and were exceeded only by Wisconsin. Cash receipts from milk sales make dairying the largest agricultural industry in California. Of the 2,323 dairies in California, about 2,144 are Grade A and produce 98 percent of the milk. The remaining 2 percent is produced by Grade B dairies.

Southern California produces approximately 27 percent of the state's milk and another 33 percent is produced in the South or San Joaquin Valley; the remaining 40% is produced in Northern California (including the North Valley, North and South Bay areas, and Del

Norte-Humboldt region). In the past 20 years, production has shifted north as urban and environmental pressures in Southern California have sent southern dairies into the San Joaquin Valley. This has created a seasonal shortfall in meeting Southern California's fluid milk needs. Consequently, about 25 percent of Southern California's bulk raw milk needs are met from milk produced in the South Valley.

Finally, a prominent characteristic of dairying in California is the relatively low cost of milk production. There appear to be several reasons for this. The climate is favorable for dairying. In other parts of the U.S., harsh winter weather requires shelter for animals; these requirements are much less in California's mild winters. California summers are dry, in contrast to the humid conditions found in other parts of the U.S. Cows can be accommodated on hot California days with simple shade structures and a water mister system. The combination of high temperature and humidity elsewhere reduces milk production.

While costs of traditional feeds in California are slightly higher than elsewhere, there are many relatively inexpensive vegetable, fruit, nut, grain, and fiber by-products available for feeding dairy cows. In addition alfalfa available in California is of much higher quality and availability than that grown in the East and Midwest because of the long growing season and controlled irrigation. Finally, the average California dairy is large enough to allow producers to capture economies of size and scale, thus reducing average per unit costs considerably.

The dairy industry in California developed because of the state's geographical location and marketing plan. It is comprised of intensive systems of management with high producing cows and low production costs. New technologies and advances through research continue to improve dairy care practices in California.

MANAGEMENT COMPONENTS

SECTION 1. CALF CARE FROM BIRTH TO WEANING

INTRODUCTION

Heifer calves are raised as replacements for lactating cows and are essential to the successful future of the dairy. The greatest mortality and morbidity period for dairy cattle is from birth to weaning. Management goals for the first 6 to 8 weeks of a calf's life should be to minimize disease and mortality by providing a suitable environment, establishing a quality nutritional program, and implementing a preventive health care plan.

FACILITIES

Health and survival of the newborn calf depend on its care and environment. Designs for calf-rearing facilities range from complete barn enclosures to minimum shelters. A wide range of acceptable housing facilities exists within California. Calf housing should provide an environment that is clean and dry and will minimize stress. Protection from heat, cold, wind, and rain is important. Adequate space, animal comfort, and proper ventilation are important in designing a facility. Facilities should be accessible for thorough cleaning and disinfecting on a regular basis to reduce the number of pathogens.

Placing the facility upwind from corrals and cow traffic decreases dust problems. Housing calves between hay stacks, barns, or other large structures that impede air movement should be avoided. This is especially critical during the summer.

Facility features which are desirable but do not necessarily influence calf health include: design for labor efficiency, conservation of space, esthetics, and location for easy access by dairy personnel but not the public. Calf theft is common, and easy public access enhances rustling potential. Storage facilities for supplies, equipment, and sanitizing materials as well as access to refrigeration for milk and health care products are also important considerations in calf housing design. These features assist in developing and maintaining a successful calf raising program.

<u>Individual Pens</u>

Individual pens separate calves and reduce the spread of communicable diseases and make it easier to observe behavior, feed consumption, and fecal and urine production. Changes in feed consumption and fecal consistency can be early indicators of disease.

Many calves are successfully raised in 2-foot by 4-foot expanded metal or slatted wood, elevated pens. More hock, leg, and joint problems are associated with expanded metal floor pens than with other systems. Plastic coated expanded metal may reduce these problems. Calves may suffer

from cold stress in elevated pens because they provide little shelter from drafts and cold in the winter. Pneumonia may also be associated with these pens when they are placed over a flush system for cleaning since pathogens can be aerosolized during the flushing procedure. Recommended modifications of the elevated pen are to double the pen size and include a bedding box filled with straw or other materials to allow for more comfort and fewer leg and foot problems (University of California, Cooperative Extension Leaflet #2327).

Hutches

Individual, outside hutches predominate in California. Most are approximately 4-foot by 8-foot wooden hutches, although other materials are used. Slightly smaller individual hutches grouped in units of three are commonly used in southern California. Hutches are more labor intensive than elevated metal pens, but they allow for complete separation of unweaned calves. Because hutches rest on the ground, calves are better insulated from drafts than in elevated pens. Hutches can be moved and modified to adjust for temperature, sunlight, predominating winds, and direction of inclement weather. Hutches are easy to move or lift for cleaning. Fiberglass and polyethylene hutches are easier to sanitize than wooden hutches or metal pens, but these should be opaque to reduce heat from the sun.

Cold Housing

Open-sided pole barns containing individual pens are referred to as "cold housing." Cold housing is adequate in most California conditions. Wind barriers, such as plywood or roll-up snow fencing material, can be used during the winter.

Closed Housing

Closed housing consists of an enclosed barn containing individual pens. The most critical aspect of closed housing is adequate ventilation. Accumulation of moisture and manure gases, such as methane, carbon dioxide, hydrogen sulfide, and ammonia, increase the potential for respiratory disease. Environmentally controlled, closed housing is expensive to construct and operate and is difficult to manage.

FEEDING AND NUTRITION

Colostrum Management

Colostrum is the milk produced by the cow prior to and during the first few days after calving. Colostrum obtained from the first milking after calving contains more protein, particularly immunoglobulins, fat, minerals, and vitamins than milk produced later. Immunoglobulins, or proteins produced by the cow's immune system, are secreted into the colostrum around the time of calving. For approximately 4-6 weeks after birth,

calves depend on the immunoglobulins absorbed from colostrum for protection from infectious agents in their environment. Proper selection, collection, storage, and feeding of colostrum are essential to a successful calf raising program. Colostrometers are used to select the highest quality colostrum for storage and subsequent feeding. Colostrometers are available to measure the specific gravity of colostrum, which should be greater than 1.106. This helps to ensure that the calf receives immunoglobulins.

The ability of the calf's intestine to absorb immunoglobulins declines within hours after birth. The newborn calf can absorb the large immunoglobulins as intact proteins which impart passive immunity. However, within 24 hours of birth, intestinal closure occurs and intact proteins cannot be absorbed. Consequently, timing is important when feeding colostrum the first time following birth to ensure absorption of intact immunoglobulins. Calves, heifer and bull, should be fed 2 to 4 quarts of high quality colostrum by bottle or esophageal tube within the first few hours after birth.

Continued feeding of colostrum from the first through the third or fourth day of life is important because immunoglobulins in colostrum vary greatly in type, size, and complexity. Each type reacts differently with the absorptive capacity of the intestinal wall. Although most immunoglobulins are absorbed only in the first few hours of the calf's life, others may be available for absorption up to 72 hours. The immunoglobulins also may have beneficial local effects in the lumen of the intestine. If there is an ample supply of colostrum, it should be mixed with whole milk and fed during the first 3 to 4 days of the newborn's life.

If a cow "leaks" milk from her udder prior to first milking after calving, much of the colostrum may be lost. Colostrum from cows that “leak” should not be used for the first feeding of a calf.

Specific immunoglobulins are produced in colostrum in response to disease or other organisms prevalent in the herd. Cows are normally vaccinated or immunized against specific diseases to produce a higher level of specific immunoglobulins in their colostrum. Such programs are best established with the assistance of a veterinarian.

If colostrum is not fed immediately after collection, it should be stored frozen or refrigerated for later use. Freezing does not destroy immunoglobulins and other nutrients in the colostrum, but does prevent bacterial growth and deterioration of the colostrum. Frozen colostrum can be thawed slowly in warm water. The microwave can lead to uneven heating and may effect immunoglobulin quality. Temperatures over 111^{o}F can destroy the immunoglobulins. If colostrum is allowed to stand in a container, it should be gently stirred before feeding since the heavier and lighter particles may have separated. Once thawed, this colostrum can be fed to the calf following birth as an alternative to feeding the dam's colostrum.

Calf Nutrition

Colostrum feeding usually ends by the fourth day, after which fresh whole milk or an excellent quality milk replacer should be fed. Milk replacers are powdered products which contain predominately dry milk ingredients. These products are mixed with water and are formulated to provide proper nutrition for the growing calf.

On some dairies, milk from medicated or "hospital" cows is fed to calves. This is not a recommended practice due to the potential transfer of disease to calves. Caution should be taken if calves destined for sale or slaughter are fed a medicated milk replacer or milk from cows treated with antibiotics. This will prevent problems associated with antibiotic residues in the meat of slaughtered calves. **All withdrawal times for medicated feeds should be followed**.

Milk replacers with protein derived from dairy products are the most easily digested. Other protein sources (fish protein, cereal flours, unprocessed soy, or meat protein) are not as easily digested. Some milk replacers are being developed that contain vegetable protein with improved digestibility.

A milk replacer should contain a minimum of 20 percent crude protein and 20 percent fat on a dry matter basis. Acid detergent fiber should be a maximum of 1 percent. The milk replacer should mix easily in water and stay in solution after mixing. Water used with milk replacers should be fresh and clean. Employees should take care to use the appropriate volume and temperature of water to ensure consistency when mixing milk replacers.

In addition to milk, dry concentrate feed (calf starter) and good quality hay (e.g. alfalfa) can be offered free choice once the calf is a few days old. These feeds should be palatable, easily digested, and high in digestible protein. Similar to water provided, these feeds should be clean and fresh.

The calf's diet should contain all known nutritional components necessary for normal growth and health relative to the calf's age, environment, and physiological requirements. Rations for calves between birth and weaning should meet or exceed recommendations of the National Research Council's Nutrient Requirements for Dairy Cattle (1989) and allow body weight gains between 1.5 to 1.7 pounds per day.

Water

Water is an essential nutrient. It is necessary for various metabolic activities, such as digestion, hydrolysis of carbohydrates and proteins, excretion of waste products, nutrient transport, lubrication of joints, electrolyte balance, body temperature control, and development of rumen function. Dairy calves initially receive most of their water from colostrum, milk, or milk replacer, and all calves should have access to clean, fresh water. The water should be free of particulate matter and low in salt and bacterial content. It should be free of pesticide residues and

other toxic substances. Water troughs and pails should be cleaned thoroughly, and water should be changed when it becomes dirty. Changing the water frequently during hot summer months provides the calf with cool, fresh drinking water and promotes water intake and the intake of calf starter and hay when fed. Consumption of starter is necessary for rumen development and weaning of the calf.

The amount of water consumed depends on the calf's age, the amount and type of feed consumed, ambient temperature, amount of exercise, and water cleanliness and temperature. Calves up to 6 months of age drink 2 to 5 gallons per day.

HEALTH CARE AND MANAGEMENT

Disease affecting the pre-weaned calf may compromise her ability to mature and produce milk. A calf treatment protocol should be established, and calf personnel trained to recognize disease early and to promptly initiate treatment. Well managed calf operations can keep death loss prior to weaning below 5%. Death losses greater than 5% indicate management should be improved. Failure in any of the following areas can contribute to increased calf illness and death: colostrum management, facility, design, sanitation, disease recognition and treatment, preventive health care, and quality nutritional programs.

Umbilical Cord

If the umbilical cord is not severed immediately after birth, it can be cut 2 to 3 inches from the calf's body. The belly area (including the cord) should be dipped in a 2 to 7 percent tincture of iodine or other approved disinfectant. The tincture of iodine will dry the cord and prevent pathogens from entering the calf's body through the cord.

Sanitation

The calf should be born in a dry, clean environment regardless of the type of housing or bedding used. Hospital pens for sick cows should not be used as maternity pens. All sick animals should be isolated from the maternity and calf areas. Pathogen exposure from accumulations of feces, urine, and spoiled feed can cause digestive and respiratory diseases. Even calves that have been fed ample colostrum may become ill if housed in an unsanitary environment.

Utensils used in feeding should be cleaned and sanitized after use. This will reduce the growth of pathogens and stimulate feed intake.

Preventive Health Care Programs

Most health problems can be minimized with proper management, including adequate nutrition, clean and dry housing, low-stress handling, prompt treatment, and vaccination. The vaccination program depends on the disease problems prevalent within a given area and herd. Common diseases of calves are associated with the digestive and respiratory tracts. In most cases, vaccines are an essential

part of a total health maintenance program that should be developed with the assistance of a veterinarian.

It is recommended that calves be vaccinated at least once prior to weaning for Infectious Bovine Rhinotracheitis (IBR), Bovine Respiratory Syncytial Virus (BRSV), and Bovine Viral Diarrhea (BVD). Vaccines must be used according to the manufacturer's specifications.

Extra Teat Removal

Extra teats (more than four) can interfere with milking and may leak, which increases the possibility of mastitis. If desired, extra teat removal should be performed as soon as possible after birth to ensure a quick recovery. Precaution should be taken to avoid unnecessary pain or distress during the procedure and recovery.

Dehorning

Animals are dehorned primarily to avoid injury to personnel or other animals, reduce feeder space requirements, and increase handling ease. It is recommended that dehorning be performed when calves are 2 to 10 weeks old. Older calves are more difficult to restrain and handle, and risk of blood loss, infection, and fly infestation increases.

A hot dehorning iron is the simplest and fastest way to kill the horn-producing cells. Caustic pastes and scoops are alternative methods, but these generally cause the animal more prolonged discomfort. A local anesthetic is recommended for animals older than 10 weeks.

Regardless of the dehorning method, a fly repellant should be sprayed on the dehorned area during fly season. Newly dehorned calves should be isolated (e.g. individual housing) from other calves to avoid licking, and be kept out of the rain until the dehorned area is scabbed over and dry.

Parasites

Some parasitic infections, such as coccidiosis, can cause serious health problems. It is recommended that a regular parasite control program be developed with a veterinarian's assistance. A clean environment is the best tool for combating parasite infections. Coccidiostats may be included in calf starter to prevent coccidiosis. As with vaccinations, products to control parasites should be used according to the manufacturer's instructions and, if necessary, under supervision of a veterinarian. **All guidelines for use and withdrawal times should be carefully followed.**

Identification

Animal identification is critical for making important management decisions, such as feeding, selection, medicating, breeding, and culling; for official production testing systems; and for registering animals with purebred cattle organizations. Dairy cattle improvement depends on identifying and breeding animals with superior phenotypic and genotypic traits. This requires accurate records on each

animal. Some breed associations require that each animal be tattooed before leaving its pen or hutch.

Animal identification may be either temporary or permanent. Temporary identification methods include ear tags, neckchains, neck straps, ankle straps, and marking crayons or paints. Permanent identification methods include ear tattoos, hide brands (hot iron brands, freeze brands, and liquid/chemical brands) computer chips implanted subcutaneously, and photographs.

The most popular type of animal identification is the plastic ear tag which is easily applied by trained personnel. An additional identification is the metal ear tag the veterinarian attaches following brucellosis vaccination. More recently, electronic identification systems have been developed that use a combination of "readers" or "decoders." Electronic identification systems may involve neck collars or subcutaneous implants which interface with milking parlor computers and are gaining popularity.

MANAGEMENT COMPONENTS

SECTION 2. HEIFER CARE FROM WEANING TO CALVING

INTRODUCTION

Weaning involves the transition from a milk replacer or milk-based diet to a forage and/or concentrate diet. Calves should be offered a starter ration in addition to milk or milk replacer, when they are approximately 1 week old. Calves should be consuming 1 to 1½ pounds of starter ration per day at weaning time, usually when they are 6 to 12 weeks old. The calf starter pro-motes rumen development and provides nutrients to support growth and health.

Generally, calves should be weaned gradually. Often, it is preferable to wait a few days after weaning before moving the newly weaned calf from the calf rearing facility to a group pen of similarly aged calves.

Birth and weaning are the two most stressful periods in a calf's life. Management errors can often lead to increased health problems and/or reduced growth. Successful weaning programs minimize stress from crowding, competition with older calves, and weather.

The period between weaning and breeding is not a time of intensive management activity. Calves should be housed to minimize weather stress and allowed free choice to water. Rations should be balanced and fed so heifers reach a breeding weight of 750 to 800 pounds by 13 to 15 months of age, with a body condition score between 3.25 and 3.5 on a 5-point scale where 1 is emaciated and 5 is obese. (All body weight and rate of gain goals are for Holsteins and should be adjusted for other breeds.)

Heifers are usually bred artificially in corrals with locking stanchions, or in a restraining chute. Various estrous synchronization methods may be used to improve heat (estrus) detection.

Replacement heifers should be fed high forage rations between breeding and calving (approximately 15 to 24 months of age). Housing should provide shelter from the elements and enough manger space for all heifers to eat simultaneously. A pre-calving body weight of 1,350 to 1,450 pounds, with a body condition score of 3.25 to 3.75 is desirable for Holstein heifers.

FACILITIES

<u>Housing Newly Weaned Calves</u>

Calves should be weaned into small groups of animals, usually 5 to 12 calves per group. Newly weaned calves should not be mingled with older calves that are already established in the corrals. Pen size is recommended to be a minimum of 200 square feet per

calf in open corrals, with at least 18 inches of feed bunk space per animal. Clean and fresh water should be provided free choice. As little as 35 square feet per calf are provided in some functional intensive housing designs. There should be enough calf pens to hold about one month's production of weaned calves so each calf spends about a month in a small group.

An alternative system is to wean calves into "superhutches," which are portable pens providing a feeder, water trough, and shelter for 5 to 12 calves. Superhutches should provide 25 to 30 square feet per calf. They can be moved in a field or pasture as needed to provide calves with a clean surface.

All calf pens should be well-drained. While wet corrals cannot be avoided in rainy weather, they should drain water so mud is minimal. Accumulated manure should be removed frequently.

Pens for newly weaned calves should have 20 square feet of shade per animal. Shades should be oriented north to south and be high enough to allow sun to dry the area under them. Shades are often built on mounds to allow calves a dry place to rest in rainy weather. In the winter, dry bedding should be provided under dry shades. In some climates, permanent or temporary windbreaks may be desirable in winter (e.g., a pile of straw bales on the windward side of the pen).

Newly weaned calves often have difficulty reaching and consuming feed that is placed in front of stanchions. Calves may not be familiar with eating from ground level bunks since they are often fed starter rations from raised buckets. They are also not accustomed to operating self-locking stanchions. A feed trough may need to be placed inside the pen until all calves become familiar eating at ground level.

Self-feeding grain tanks are not recommended for newly weaned calves. Soiled and wet grain may accumulate in the trough which can promote mold growth. If self-feeders are used, the feed in the troughs must be kept fresh to maintain adequate feed intake.

Continuous access to clean, fresh water is essential for optimum health, feed consumption, and growth rates. Each pen should have a water trough that is small enough to allow water to remain fresh, but large enough so all calves have access to water when they require it. A trough that is at least 6 feet long and 4 to 5 inches deep is ideal for groups of up to 15 calves. The water trough should be located for easy calf access in a shady area and should have a drain plug for easy cleaning. It should be located so that overflow and drained water will not create a muddy or slippery area. This is usually accomplished by placing it on or near the concrete apron behind the stanchions. Water troughs should be cleaned regularly to remove fecal contamination, feed, algae, and other foreign matter.

Fences and gates should be secure. Loose rods, cables, and wires should be repaired promptly to avoid injury to calves and handlers. Gates should be arranged so calves can be sorted and easily moved from pen to pen.

Housing Heifers from the Second Month After Weaning to Breeding

Group size may be increased as calves become older. If heifers are weaned at 60 days of age, heifers from 90 to 150 days may be housed in groups of 30. Groups of 60 to 100 may be suitable from 150 days to breeding. After 150 days, heifers may be placed on pasture or housed in groups of up to 200. Heifers should be sorted so that groups are uniform, with individual calves having no more than an approximate 10 percent weight variation from the mean of the group.

Once calves learn to eat through stanchions, stanchion line feeding can be used. Self-feeding tanks may also be used, provided they are monitored frequently and cleaned as needed. Pen area and manger length requirements are outlined in Table 1.

Pens should be graded to prevent mud accumulation. Shade is recommended, especially in hot climates. Water troughs should be small enough to allow water to remain fresh but large enough to allow all animals free access to water.

FEEDING AND NUTRITION

Rations between weaning and first calving should meet the National Research Council's Nutrient Requirement for Dairy Cattle (NRC, 1989). Growth rates exceeding those in the NRC are attainable, although, if they cause fattening, they are not desirable.

Table 1. Space Requirements for Growing Heifers in Semi-Arid Climates

Age (months)	Stanchions/10 ft.	Shade ft^2/head	Corral ft^2/head
1.5 to 5	7	20	200
6 to 16	6	30	300
17 to 26	5	30	400

Source: Wiersma, F., W.T. Welchert and D.V. Armstrong. 1991. "Planning Ahead." The Dairyman 72:28.

Newly Weaned Calf Nutrition

Milk feeding is usually discontinued 4 to 5 days before the calf is placed in a group pen, but only if the calf is eating at least 1 to 1 ½ pounds of calf starter daily. Some dairy producers reduce milk feeding to once a day during the second month to encourage calf starter consumption. The presence of fresh clean water increases dry feed intake.

Newly weaned calves should be fed free-choice the same starter grain mix introduced before weaning. Rate of gain should be 1.5 to 1.8 pounds per day, with a maximum of 2.3 to prevent fattening. Calves may be fed at least 5 pounds of starter grain per day and have free-choice access to hay. Calf starter grain mix should contain 16 to 18 percent crude protein. Cottonseed products should be limited in the ration, since cottonseed contains gossypol, which is toxic to calves. Alfalfa hay for newly weaned calves should be soft stemmed, leafy, green, and palatable, with a crude protein of at least 20 percent and a total digestible nutrient (TDN) content of at least 54 percent on a 90 percent dry matter basis.

Feeding Programs from 30 Days Post Weaning to Breeding

Calves are usually fed hay and starter grain mix for about one month after weaning. Then calves may be fed a grower mixture (approximately 14 percent crude protein concentrate) with forages. After 120 days of age, calves may be fed a total mixed ration (TMR), although some dairy producers successfully feed a TMR much earlier.

Requirements for growth after 180 days of age can be met with high quality forages and higher fiber by-product feed stuffs. Some grain supplementation may be necessary to attain growth rates of 1.5 to 1.8 pounds per day or more. Since feed intake varies with ingredient quality and weather, growth rate and body condition of heifers should be monitored and ration adjustments made as necessary. Salt or trace mineralized salt should be available in block or loose form if it is not included in the ration.

Breeding to Calving Nutrition

Pregnant heifers are usually fed high forage diets until a few weeks prior to calving. The goal is for Holstein heifers to calve at 24 months of age with a precalving body weight of 1,350 to 1,450 pounds, body condition of 3.25 to 3.75 on a scale of 1 to 5, and wither height of at least 52 inches. Salt may be withheld from close-up, periparturient heifers in herds where udder edema is a problem.

HEALTH CARE AND MANAGEMENT

Health and well-being of heifers are largely determined by the adequacy of the facilities and management. When adequate facilities management cannot be provided, heifer calves should be raised off the dairy in specialized facilities. This is acceptable as long as transportation practices are safe and

humane.

Many calf disease problems have their origin in housing, management, feeding deficiencies, and weather stress. Severe weather can predispose calves to sickness even with the best heifer raising programs.

Age of Weaning

Calves may be weaned from milk or milk replacer as early as 30 days of age and removed from hutches to group pens as early as 40 days. However, milk usually is discontinued at 45 to 55 days and calves removed from hutches at 55 to 65 days. While some producers leave calves in hutches and feed milk or milk replacer for up to 90 days, this can be counter-productive as the heavier calves require additional feed and water to allow for optimal growth. Larger calves also produce more feces and urine, thus requiring supplemental bedding and waste removal to keep the environment clean and dry.

Since the birth rate of heifer calves is not constant, weaning age can vary. For example, if a large number of heifers are born and all hutches are full, some calves may require early weaning. If weaning pens are full, weaning may be delayed. This is acceptable if feeding programs are adjusted and housing facilities are kept clean and dry.

Breeding

Heifers may be bred artificially using the same techniques used for milking cows. They may be placed daily in stanchions for estrus (heat) detection with the aid of tail chalk or heatmount detectors. Heifers on pasture or in pens without stanchions may be heat detected by observation and then bred in a restraining chute. Heat detection may be facilitated by synchronizing the estrous cycle of heifers. This is accomplished with progesterone implants and/or prostaglandin injections.

After artificial insemination, heifers are often placed in groups with breeding age bulls to allow natural service of those animals that did not conceive with artificial insemination. Heifers not conceiving should be palpated rectally to determine reproductive tract status abnormalities. Low birth weight or calving ease sires should be used to minimize calving difficulties.

Identification and Records

Heifers usually are identified with plastic ear tags shortly after birth. They may be given numbers in a separate series from that used in the milking herd or receive a number that will follow them until they leave the herd. They are often retagged at the time of first calving with their permanent cow identification number.

It is useful to write the calf's birth date on the tag to allow easy evaluation of growth rate relative to herdmates. Heifers also receive a metal brucellosis identification tag at the time of vaccination by a veterinarian. This provides a unique number that is often used for testing and regulatory purposes.

Extensive records are not usually kept on heifers but are encouraged. Births and deaths should be recorded. Most dairies with computer records initiate animal records at birth. Records of treatment of sick animals should be kept to avoid residues if an animal is slaughtered for food purposes. Breeding dates, sire identification, and pregnancy diagnosis results are usually recorded in computer records. Additional records that may be helpful are body condition scores, average daily weight gain, mastitis, or other health problems.

Vaccination Programs

Vaccinations recommended for heifer calves include Infectious Bovine Rhinotracheitis (IBR), Bovine Respiratory Syncytial Virus (BRSV), and Bovine Viral Diarrhea (BVD) at 4 to 6 months of age and again before breeding. They should be vaccinated with Leptospirosis bacterin at those times and again at pregnancy diagnosis. Clostridial vaccination may be beneficial in certain regions. Pregnant heifers may be vaccinated with J-5 *E. coli* bacterin before and at calving to help prevent coliform mastitis during lactation.

Heifer calves should be vaccinated for brucellosis between 4 and 8 months of age by a veterinarian. At this time they are tattooed in the right ear and a permanent metal brucellosis vaccination identification or USDA series number tag is placed in the right ear.

Parasite and Fly Control

Flies breed readily in a moist, warm environment. Wet, organic bedding and accumulated manure create an ideal environment for fly breeding. Flies can be a significant stress on young calves. Control should be based on destruction of fly larva habitat by moving calf hutches frequently and removing accumulated bedding and manure.

Fly larvae and pupae also live in corral manure, especially in relatively undisturbed areas such as weedy fence lines, around water troughs, and behind stanchions. Some species of flies breed in piles of straw, hay, and other organic debris. Keeping a farm neat and clean and removing manure from under fences and behind stanchions can help reduce fly numbers. Insecticide dust bags in corrals help keep adult flies off calves. Spraying corrals and haystacks with approved insecticides can temporarily reduce the number of adult flies. Chemical control of flies should not be the sole method for fly control. All labels should be reviewed before chemicals are used because there are various milk and meat withdrawal periods.

Heifers kept on pasture should be dewormed on a schedule that is designed for local climatic conditions. Purchased heifers of unknown origin should be dewormed at least once prior to calving. Heifers housed only in drylots do not require deworming.

Feed Additives

Infection with coccidian parasites can cause no noticeable signs of illness to severe symptoms of profuse diarrhea. A coccidiostat (Decoquinate™, Lasalocid™, or Monensin™) should be fed as a supplement from weaning to 180 days of age and may be fed prior to weaning. Ionophores (Monensin™ or Lasalocid™) also act as coccidiostats and may be fed to increase feed efficiency and weight gain. These products should only be used according to manufacturer's directions or under supervision of a veterinarian.

Oxytetracycline, chlortetracycline, or chlortetracycline/sulfamethazine feed additives may be used to help prevent respiratory disease. These products are useful when calves are subjected to adverse weather and stress, before and during stressful management procedures such as vaccination, weaning, or dehorning, and to help contain out-breaks of respiratory disease. **Observe all withdrawal times to avoid residues in meat of slaughtered calves.**

Treatment Facilities

A hospital pen is recommended for the dairy to isolate and treat sick calves. Locking stanchions make observation and treatment easier. All calves should be observed daily and sick or injured calves treated promptly.

MANAGEMENT COMPONENTS

SECTION 3. CARE OF COWS AND CALVES DURING THE PERIPARTURIENT PERIOD

INTRODUCTION

Proper care of the periparturient (around calving) cow and calf depends on facility design, management, training of personnel, health care programs, nutritional programs, and economics. Health and comfort of the cows and calves should be the main consideration. Calving is a high risk event in terms of cow health and is associated with most of the health problems requiring treatment. Preparation and care during this period will minimize sickness and death of the heifer, cow, and calf. Facilities should be designed to be safe, effective, and easily cleaned.

FACILITIES

The main objectives of a calving facility are to minimize disease and stress to both the cow and calf. Convenience and employee working conditions are secondary considerations for these facilities. Properly managed sod pastures can be ideal calving areas during the summer, but they are often muddy during the winter. Additional time is required for frequent observation of cows calving on pastures.

Maternity and calving pens are an alternative to pasture calving. In large herds where calving is concentrated in a small area, sanitation is extremely important. Sanitary conditions will minimize disease and stress to both the cow and calf. Pens should be designed for ease of cleaning. Well-grooved concrete floors are preferable so the pen area can be thoroughly washed while allowing for good traction and secure footing. Clean bedding should be provided in sufficient amounts for cow comfort. The calving facility should have a roof to provide shade in the summer and protection from rain in the winter and spring.

The calving facility should be located where animals can be easily and frequently observed by the herd manager, milkers, and other dairy personnel. Calving assistance should be provided when necessary. It is desirable to have a vacuum line and stopcock located in each pen or nearby to facilitate milking the fresh cow to obtain colostrum. Access lanes to and from the facility are important for ease of cow movement and to segregate fresh cows from the rest of the milking herd.

A supply or utility room should be near the calving area to provide for safe and convenient storage of calving equipment and refrigeration of health care products and colostrum. A sink and running hot and cold water for

cleaning equipment and utensils are also recommended in a well-planned calving facility.

Close-up Cow (close to calving) Pens

Cows should be moved about two weeks prior to their expected calving to a "close-up" pen where they can be frequently observed. Cow density in the close-up pen should be about one-half of the density in lactating cow pens for hygienic purposes and to allow cows in labor some space to move away from herdmates. Calving in the close-up pen should be avoided. It is desirable to have cows calve in a special maternity area. Cows should be moved to the maternity area when parturition is imminent.

Maternity Area

Cows naturally isolate themselves to give birth. The maternity area should provide a secluded area for parturition. Clean pasture is a desirable environment for calving but is impractical on most large, commercial dairies in California. Individual or small group pens are most suitable and are widely used in the southwestern United States. There should be one clean maternity pen for each calving cow. The pens should provide at least 100 square feet per cow. The maternity area should be well-ventilated but not drafty. Supplemental lighting should be available. The area should be clean, well-bedded, and free of unnecessary disturbances.

A locking stanchion should be convenient to the maternity area for cows requiring assistance at calving. The facility should be designed so that one person can move the cow to the locking stanchions area, restrain her and render obstetrical assistance. The stanchion should be designed to prevent choking if the cow falls (i.e., the bottom of the stanchion should be close to the ground). The calving stanchion should have long gates which can be swung out of the way once the cow is restrained.

FEEDING AND NUTRITION

Cows within 10 to 16 days of calving are normally fed as a separate group from other dry cows. A few pounds of a grain concentrate mix may be fed to these "close-up" cows in addition to forages. This practice avoids a sudden shift from an all-forage ration to a ration with a high proportion of concentrates which is typical of that fed to cows in early lactation. Feeding grain also increases rumen papillae length and reduces incidence of ketosis. A sudden shift in ration ingredients and amounts following calving can cause gastrointestinal disturbances and predispose cows to other metabolic problems. For a 1,500 pound close-up dry cow, 5 to 8 pounds daily of concentrate mix are recommended, depending on the body condition of the cow and the quality of the forage being fed. Cows with chronic mastitis, pendulous udders, a history of calving difficulty, and obese cows should receive reduced levels of concentrate

before calving. Salt may be withheld from rations to reduce udder edema.

Rapid ration changes at calving should be avoided. If the postpartum cow is to be fed a total mixed ration, it may be beneficial to feed about five pounds of long-stemmed hay in the ration for at least 10 days after calving to stimulate feed intake. This will help prevent cows from refusing feed after calving and the associated digestive malady of a displaced abomasum. Large dairies may have a fresh cow string where cows remain for 5 to 10 days post-calving. These diets are formulated to promote feed intake and minimize the incidences of milk fever and displaced abomasum.

HEALTH CARE AND MANAGEMENT

Calving Assistance

About 25 to 30 percent of the heifers require assistance at first calving. Second or later lactation cows require assistance about half as often. Assistance should not be given as long as the cow is making satisfactory calving progress. Heifers should be bred to low birth weight or calving ease sires to decrease the incidence of dystocia (calving difficulty). Knowing when to give assistance at calving comes with experience, so managers should train maternity personnel.

Personnel responsible for assisting calving cows and heifers should be trained in proper obstetrical procedures. Hot and cold water and soap, for washing the cow and obstetrician, and clean calving equipment should be readily available. Hygiene and lubrication are critical to cow and calf health. The cow's perineal (around the vulva) area should be washed thoroughly and the tail tied to the cow to keep it out of the way. The obstetrician should avoid contamination of the reproductive tract as much as possible by making sure that hands, arms, and instruments are clean. If extra lubrication is required, a water soluble lubricant which is non-irritating to the reproductive tract is preferred.

Gentle traction applied to the calf minimizes damage to both the calf and the cow. No traction should be applied until the birth canal is open and the calf is in proper presentation for delivery. The trained obstetrician applies traction when the cow is contracting and maintains gentle pressure between contractions, allowing the cow to rest. The person assisting should know his/her limits and call for veterinary assistance when needed. If a Cesarean section is necessary, it is best to make the decision early before the cow, calf, and obstetrician are exhausted. Under no circumstances should motorized equipment be used to extract a calf.

Postpartum Care of the Cow and Calf

After a cow gives birth and before she is released from the calving area, she should be examined to ascertain whether she has a second calf which has not yet been born. Cows that have twins or require assistance are

more likely to retain the fetal membranes and/or develop a uterine infection. These cows should be observed more closely than cows that had normal, unassisted calvings. Cows normally expel the fetal membranes within 24 hours at calving.

Cows which become paralyzed during calving should be kept in a comfortable, well-bedded area with feed and water available. An early determination of the cause of paralysis will help determine if the cow should be culled or appropriate care administered to return her to health. A cow that is recumbent for more than 24 to 48 hours is not likely to recover. Appropriate care may include attempts to utilize a water tank designed to "float" cattle or periodically rolling the recumbent cow to her opposite side.

In even the most hygienic calving areas, there are millions of microorganisms which will contaminate the cow's reproductive tract and the calf. Most cows and calves are able to overcome the contamination with no clinical problems. Cows requiring treatment with antibiotics should be properly identified and treated according to a protocol designed by the herd veterinarian and dairy manager. The protocol should be designed to combat microbial infection and **avoid any milk and meat residues**.

MANAGEMENT COMPONENTS

SECTION 4. LACTATING DAIRY COW CARE

INTRODUCTION

The performance, health, and welfare of the lactating cow are reflections of the quality of care received at every stage its life. Performance depends on converting feed nutrients into milk. Over the last 20 years, milk production has increased markedly due to improvements in genetics, nutrition, milking systems, facility design, health programs, care, and management. The welfare and care of the lactating cows are critical for the success of the dairy and providing the consumer with a safe and wholesome dairy product.

FACILITIES

Proper facility design reduces stress and provides for comfort, proper nutrition, and health of the lactating cow. Temperatures under 40°F (4°C) may adversely affect lactating cows. Cold stress symptoms in dairy cattle are difficult to observe. The cow adapts to the stress of cold weather by increasing appetite and diverting energy from milk production to producing body heat. A heavier winter coat also helps the animal adapt. Rain and fog do not directly harm the cow. However, mud in corrals increases the risk of mastitis, and frozen, crusty mud may injure the teats and udder. Cows housed in mud may have increased nutritional requirements for body maintenance of up to 20 to 50 percent.

Cow productivity can also be decreased by temperatures over 75°F (24°C) and is aggravated by high humidity. The heat-stressed cow eats less, and milk production is reduced. Signs of stress, such as panting or standing in water, are not obvious until prolonged exposure to extreme temperatures or humidity occurs. Heat stress is compounded when the temperature does not fall below 70°F (21°C) at night.

In the southwestern states, most enclosed dairy barns have open sides which provide for air flow. Barns that are not properly constructed and ventilated can accumulate heat, moisture, and gases. All of these factors can have detrimental effects on the cattle and dairy employees. A gap at the roof peak allows for the natural venting of warm air, moisture, and gases. Additional air movement can be provided by low-speed, high-volume fans.

Natural and electric lighting should be provided. Insufficient light in the barn makes it difficult for workers to observe and detect problems with the animals or the barn.

Freestalls

Freestalls are individual cow bedding areas where partitions orient the cow for comfort and sanitation. The typical dairy using a freestall barn does so to facilitate cow comfort and manure handling. Freestalls give the cow a dry and comfortable place to lie down for rest and rumination.

Freestall barns should have one stall for each lactating cow. Some operators may choose to provide more stalls to accommodate herd growth and to provide areas for subordinate animals to move away from more aggressive herd mates.

Freestalls should be designed and maintained for cows that are about 10% larger than the herd. Stalls that are too short or narrow make it difficult for the animal to rise. Some configurations may entrap the animal, resulting in injury or death. Stalls that are too long or wide allow the animal to move forward so that feces and urine are deposited within the stall and not in the alleyway. It is desirable to use excess bedding and devices which prevent the forward movement of the animal within the stall.

Animals will back into stalls unless the stalls are protected with so-called "back-out" devices. An arm or other device that contains a steel rod which moves upward as the cow rises is preferred. The rod or pipe must be heavy enough to encourage the cow to back out. Back-out control devices should be effective without creating a safety hazard. For example, the use of a heavy wire cable stretched tightly over the row of stalls is effective but can be dangerous.

The choice of bedding material is influenced by cow comfort, sanitation, waste system, disease risk, cost, availability, and farm maintenance. Bedding material should be dry, drain well, and not contain or support the growth of bacterial pathogens at a level that increases the risk of udder infection. Bedding material should be soft and resilient examples are: gravel, kiln-dried shavings, beach sand, and dried manure. The accumulation of feces and urine, along with the gradual reduction in bedding material, results in an uneven, wet, microbe-laden depression that increases the risk of udder infection and the potential for the animal to step on her udder as she attempts to rise. Bedding material must be maintained by removing wet or soiled material in a timely manner and replacing it with fresh material. Tractor mounted devices for smoothing bedding in freestalls are effective in helping to maintain a level surface for cows to lie on.

Cow mattresses consisting of coverings filled with ground rubber or other materials have been used with success on some dairies. They require less maintenance than traditional freestall bedding materials. If they are not designed correctly and comfortable for the cows, they may not be used as frequently. Cows should spend much of their non-eating, non-milking time

lying down and ruminating.

Loose Housing

Barns, shades, and corrals form the loose housing unit for the dairy cow. Ideal loose housing provides thermal and physical comfort and minimizes disease. Facility design and size depend on cow numbers, climate, and waste handling techniques. Overcrowding often aggravates adverse conditions, such as excess moisture, accumulation of manure, or reduced ventilation. This can predispose the cow to health problems, such as mastitis and pneumonia, and increase the number of insect pests. Overcrowding also affects cow behavior and may reduce access to feed, water, or resting areas for some subordinate animals.

The recommended loafing space for each cow in loose housing is 40 to 50 square feet of roofed area, in semi-arid conditions. The recommended space in unpaved earthen exercise corrals for groups of 100 cows is from 500 to 600 square feet per animal. Corral space may be reduced to 100 square feet on paved lots. Guidelines for housing in cooler climates are 20 to 30 square feet of roofed area per head for small breeds, and 30 to 40 square feet per head for large breeds. These considerations are equally important for waste removal and cow comfort.

In semi-arid conditions, loose housing roofs are often 10 to 12 feet wide, with similar height dimensions, and oriented north to south to allow the sun to dry the bedding. Wider-roofed structures should be oriented to allow for maximum natural air flow. Haystacks and other large objects should not be located where they impede air flow.

Bedding materials in dry weather can be dirt and dry manure, with weekly scraping to facilitate drying and reduce insect breeding areas. Straw or sand are preferred wet weather bedding materials. Wood shavings and sawdust can harbor high numbers of mastitis pathogens if not kiln dried. Cotton stalks and gin trash are not permitted by the California Department of Food and Agriculture for bedding because of herbicide and pesticide residues.

To reduce slippage, surfaces in loose housing should include scarified concrete areas, 15 to 20 feet wide around water troughs, feed bunks, and entrances. It is advisable to score the surface perpendicular to cow traffic. Crisscross scoring gives better footing. Finely crushed rock is an alternative flooring; however, large pebbles which can bruise hoof tissue should be avoided.

Loose housing and corrals that are hard-surfaced generally require a 4 percent slope for proper drainage. Dirt lots may need a 4 percent slope or more, depending on soil type and rainfall. Surface pumping to remove storm water from a corral area can help reduce mud problems. However, corral scraping and excess manure removal before and after the rainy season are necessary.

Feed manger configuration, placement, and width per cow are factors in reducing stress and increasing comfort for dairy cows. Length of feeder space per cow affects time available to eat and amount of feed the bunk can hold. Cows are normally allowed 2 to 2 ½ feet of manger per cow. Feed mangers must be cleaned regularly. This is particularly important with high moisture feeds during hot weather, since they can ferment and spoil if not consumed.

FEEDING AND NUTRITION

Each cow should be offered a balanced ration that meets the nutrient requirements outlined by the National Research Council's Nutrient Requirements for Dairy Cattle (1989). These nutrients include energy, protein, fiber, vitamins, and minerals. Many digestive disorders can be prevented by not feeding more than 60 to 65 percent of the diet as concentrate ingredients. Careful management of the body reserves of dairy cows is crucial to efficient production because body fat is a necessary and important energy source for lactation in the first few weeks after calving. However, excessive body fat before calving is associated with increased metabolic diseases, calving problems, and culling. Body condition of cows and heifers should be evaluated regularly so feeding and management practices can be appropriately altered.

Commodity by-product feeds can economically be included in a dairy ration. Several factors need to be considered before a by-product feedstuff is fed. Many by-product feedstuffs contain high moisture levels which makes them prone to spoilage and will reduce palatability and quality of the ration. By-product feeds often vary in nutritive content and should be regularly assayed for their moisture, nutritive content, and pesticide residues.

Toxins produced by molds are called mycotoxins. When mycotoxins are consumed in small amounts, symptoms may be absent or be evidenced by reduced milk production and appetite. Cows may abort and, occasionally, die. Feed quality should be maintained by suitable storage conditions. The feeding value of moldy or spoiled feed is related to the extent of spoilage and the age and type of animal to be fed.

To prevent the ingestion of small pieces of wire, baling wire should be carefully disposed. Magnets on the chutes of feed wagons will catch iron debris. Care should be taken to prevent nails and other metal from falling into feed mangers. Rumen magnets should be administered to cows. Magnets stay in the reticulum and collect metal fragments to prevent them from piercing the rumen wall.

Water

Animals need fresh, clean drinking water for normal growth and production. A dairy cow consumes about five gallons of water per gallon of milk produced daily. Cows are particularly sensitive to water problems

because of the large volume they drink.

Excess nitrate, salt, bacteria, algae, or chemicals can decrease consumption of water and cause adverse health effects. The sources of these contaminants may include septic tanks and dairy wastes. Elevated nitrate levels may affect reproduction, number of abortions, growth rate, respiration, and mortality. Mature animals can tolerate fairly salty water, up to approximately 3000 milligrams per liter total dissolved salts. Animals in late gestation that consume excessive salt may experience severe udder edema at calving. Excess bacteria and algae generally do not cause health problems but may contribute to decreased water consumption. Water troughs should be cleaned regularly.

HEALTH CARE AND MANAGEMENT

General

Dairy cow management can contribute to many of the common and economically significant diseases. Common diseases include mastitis, reproductive tract infection, foot disease, and gastrointestinal problems. Prevention of disease requires a multi-disciplinary approach to management, including facility design and operation, nutrition, waste management, animal selection, and veterinary medicine.

Mastitis

Mastitis is the most common disease of the dairy cow. It results from a microbial infection of the udder where bacteria gain entrance via the teat openings. Subclinical mastitis is the most prevalent, and does not result in gross changes in the milk or severe abnormalities in the animal. However, subclinical mastitis may progress to clinical mastitis. Clinical mastitis results in reduced milk yield and is a common reason the cow is culled prematurely.

With clinical mastitis, there are observable signs of dysfunction. These include swelling and/or redness of the udder, discomfort, and abnormal milk secretions. In some cases of clinical mastitis, systemic disease such as diarrhea, loss of appetite, dehydration, and even death occurs. Some severely affected animals may become non-ambulatory and will require special handling as described in Section 7, "Care and Handling of Animals Destined for Sale or Slaughter."

The emphasis on mastitis control should be prevention. The keys are proper sanitation and management of non-infected and subclinically infected animals. Wet, manure-laden areas in the lactating and dry cow pens and bedding areas, and poor sanitation during the milking process increase the risk of mastitis. Udders should be clean and dry when milked. Teats should be sprayed or dipped with disinfectant after milking.

Foot Care

Healthy feet are important to the productive cow. Lameness will interfere with movement to the milking

facility, obtaining feed and water, exhibiting estrus, and general health. Foot rot, laminitis, hairy foot warts, etc. can cause severe discomfort for the dairy animal and be a source of economic loss to the dairy. The first sign of foot rot is lameness that may involve one or more feet. In acute cases, lameness is followed by swelling of the foot, spreading of the toes, and an abscess above the hoof. If not corrected, the infection will spread deeper and infect the joints, resulting in chronic arthritis.

Feet should be trimmed at regular intervals to maintain proper foot conformation and prevent losses due to lameness. Management practices that help reduce hoof damage and avoid bruising will help reduce the incidence of foot disease. Proper drainage of all locations to minimize standing water also helps. Early detection and treatment will help minimize the incidence of foot disorders. Various types of foot bath solutions may be used to decrease the incidence of some foot diseases.

Switch Trimming and Tail Docking

Tails of milking cows may be carriers of fecal matter, mud, and other contaminants which become a nuisance in the milking parlor. It has been hypothesized that disease may be transmitted from pathogens carried on the tail to the employees and equipment during routine milking procedures. Although not documented, it is thought that udder health and milk quality may be improved by minimizing contact with contaminated tails. To lessen the physical contact between the cow's tail and the milker the trimming of the switch or docking of the tail is sometimes utilized. The more common practice is switch trimming which involves the periodic trimming of the long hairs growing at the distal end of the tail. Tail docking is performed by placing an Elastrator band (similar to a rubber band) on the tail for approximately seven days, then removing the distal portion of the tail with a sharp, sanitized instrument. The majority of the tail is usually removed; however, a portion remains to cover the length of the vulva. Tail docking is not a routine practice on most California dairies with the exception of a small percentage of dairies using a parallel milking parlor.

Dairy management should seriously address the possible advantages of tail docking versus the loss in the ability of the cows to switch away biting insects, especially flies, the risk of infection, and the loss of the tail as a communication signal to herd mates and caretakers of behaviors such as irritability and pain. **No data have been published to support the claims of improved milker comfort and health or better udder hygiene and milk quality (e.g. lower somatic cell counts) in cows with docked tails.** Tail docking is illegal in some countries due to welfare consideration and trade policies.

Machine Milking

Machines with a partial vacuum

are used to remove milk from the udder. Vacuum levels between 12 to 14 inches of Mercury are normal. Cows should have clean, dry udders before the milking machine is attached. Pulsators, regulators, air hoses, and liners require regular maintenance to function properly.

HANDLING AND BEHAVIOR

Lactating cows are moved and handled several times daily. The manner in which cattle are handled affects the safety and welfare of both the animal and the personnel. Cows are gregarious and do not like to be isolated. They are also creatures of habit and do not easily adapt to new situations. From an early age, cattle should be handled quietly. Pain should not be used as a motivator.

Alarming sounds and force may be effective in the short term but can result in cow behavior that is erratic, explosive, and unpredictable. Hydraulic systems used for operating stalls and gates within the milking parlor should be fitted with over-pressure relief valves to assure that the forces generated do not injure the cattle.

MANAGEMENT COMPONENTS

SECTION 5. DRY COW CARE

INTRODUCTION

A "dry" cow is a cow that is not producing milk (lactating). Daily milking is usually ceased abruptly after a dairy cow has been lactating for 10 to 12 months. The dry period (non-lactating) ideally begins 40 to 60 days prior to the next calving.

The dry period allows for involution and regeneration of milk secretory tissue in the udder. This process takes 3 to 4 weeks. Cows which are given a dry period of less than 30 days will produce less milk in the subsequent lactation. A minimum dry period of 55 to 60 days after the first lactation, and 50 to 55 days after the second lactation is recommended. Older cows require a minimum dry period of 40 to 50 days. A dry period of more than 70 days can contribute to obesity at calving. Obese cows are more likely to have calving difficulties and metabolic disorders.

FACILITIES

Dry cows are usually housed in groups. Corral space, loafing area size, and protection from weather depends on cow numbers, climate, and waste management considerations. In unpaved, earthen corrals under semi-arid conditions, approximately 500 to 600 square feet of loafing area and 40 to 50 square feet of shade per cow are recommended.

Freestalls are becoming more common in California. These are individual stalls which are open in the back so cows can freely enter and exit. If freestalls are used, there should be one stall per cow. If overcrowding is unavoidable at times, cow numbers should not exceed available freestalls by more than ten percent. Freestalls should allow 25 square feet per cow. Exercise pens should allow 100 to 200 square feet per cow. These recommendations are important for both waste removal and cow comfort.

Corrals should be free from standing and running water and graded to an approximate slope of 4 percent for drainage. Surfaces may be concrete or earthen. Corrals should be cleaned and scraped regularly. Clean, fresh drinking water must be accessible at all times. An overflow drain and a 10-foot concrete apron around the water supply is desirable. Shade should be provided in outside corrals. Trees and other natural objects can provide adequate shade. Feeding locations should be designed to encourage adequate exercise.

FEEDING AND NUTRITION

The feeding program during the

early part of the dry period is aimed at stopping milk production. Eliminating grain concentrates, high-quality legume forage, and corn silage from the ration reduces milk production. These feedstuffs can be replaced with lower-energy, high fiber forages such as grass or oat hays. Rations should meet National Research Council's Nutrient Requirements for Dairy Cows (1989).

Nutrient and energy requirements for dry dairy cows are lower than for lactating cows. The feeding program during the dry period will vary depending upon the cow's calving date, but should be designed to adjust body condition, provide for growth of the fetus, and prepare for lactation. The energy requirements of the dry cow are lower than the lactating cow. Forages, such as hay, can be used as the primary feedstuffs in dry cow rations and are usually the least expensive source of required nutrients. These fibrous feeds help maintain the strength of ruminal muscles and general rumen health.

Cows entering the dry period in proper body condition (body condition score of about 3.5) should be fed only roughages such as hay, pasture, greenchop, and silage until about three weeks before calving. Mineral supplementation may be necessary with some roughage sources. These dry cows should gain 1 to 1.5 pounds per day to allow for the growth of the fetus. Thin (condition score below 2.50) dry cows should be grouped separately and fed a higher energy ration to allow them to regain optimal body condition. Obese cows (condition score of 4.00 or above) will have more calving and health problems. These cows should be grouped separately and fed low quality forages with protein supplemented separately. All dry cows should be fed diets with crude protein levels of at least 15% of dry matter intake.

The total intake of calcium, phosphorus, and potassium during the dry period is critical. These three minerals must be fed in amounts very close to animal requirements to keep the gut absorption mechanisms active. Excess quantities of any of these minerals will predispose the cow to milk fever (parturient paresis or periparturient hypocalcemia), downer cow syndrome, and other related problems. Milk fever will predispose the cow to other serious health problems such as dystocia, prolapsed uterus, retained placenta, uterine infection, and mastitis.

The recommended feeding program for dry cows during the last 10 to 16 days before calving is described in Section 3, "Care of Cows During the Periparturient Period."

HEALTH CARE AND MANAGEMENT

Cows recently dried off should be carefully monitored until their udders no longer produce milk. Cows developing hard, swollen quarters should be milked out. This will help remove the bacteria and toxins responsible for the inflammation. Approximately half of all new mastitis

new mastitis infections occur in the early dry period. Cows are also particularly susceptible to new infections when milk is present in the udder. Therefore, it is important to keep dry cows in clean corrals or pastures especially close to calving.

Dry-cow therapy is an important component of a mastitis control program because it reduces the number of persistent udder infections and new dry period infections. Dry-cow therapy consists of infusing at the end of a lactation each quarter of the udder with a registered, Food and Drug Administration approved, long-lasting antibiotic. It is most beneficial if all four quarters of all cows undergo treatment at the end of each lactation. If the herd level of contagious mastitis is low, the producer and the veterinarian may consider treating only cows that have a record of mastitis infection or high somatic cell counts.

Dry-cow therapy has several advantages over treatment of mastitis during lactation. During the dry period, higher drug dosages can be used safely since the antibiotics remain in the udder of the non-lactating cow which increases the cure rate and reduces the risk of milk contamination from drug residues compared to lactational therapy. A sterile, individual syringe should always be used to avoid introducing infectious organisms into the udder. **Always read and follow the manufacturer's label instructions. Observe withdrawal times to avoid residues in meat and milk.** Immediately after administering dry treatments, the cow should be removed from the milking string. Cows should be observed for any complications for 7 to 10 days after treatment .

Other health treatments may be administered at this time, depending upon local disease problems and specific herd problems. Any necessary vaccinations should be scheduled well in advance of calving to allow the production of desired immunoglobulins in the colostrum. Cows with diagnosed parasite infections can also be treated during the dry period. Directions should be carefully followed on all vaccines and medicines, as certain modified live virus vaccines and some drugs can cause abortion.

MANAGEMENT COMPONENTS

SECTION 6. CARE OF THE DAIRY BULL

INTRODUCTION

Bulls of various ages are common on dairies. Management practices including feeding and nutrition, health, and housing requirements from birth to puberty are similar to those for raising heifers (see Section 1). Bulls may be housed with growing heifers of similar age prior to reaching puberty. After puberty, bulls should be raised in separate pens from the heifers.

Many dairies use bulls to breed cows that did not conceive with artificial insemination (AI), were not detected in heat and bred by AI, or aborted early in gestation. These bulls are referred to as 'clean-up bulls,' and they are housed with cows in group corrals. Clean-up bulls are often purchased from registered breeders to provide superior genetics for the herd. Some bulls used for natural service also may have had semen collected and distributed to other dairies for AI. The progeny from these matings allow evaluation of the bull based on the performance of his progeny. Bulls with superior genetic potential will then leave the dairy and enter a commercial AI organization. Bulls that are no longer needed for breeding are sold for meat.

Bulls are large, powerful animals and handlers should always be cautious. Most dairy producers sell bulls for slaughter when they become aggressive or too large. Consequently, most clean-up bulls are two years old or younger. Breeding bulls can be housed in open corrals or freestall barns with lactating cows. In some areas, pasture breeding is practiced and, thus, bulls remain on pasture. Corral fences and gates used for the milking herd are usually adequate for bulls. Likewise, shade, free stalls, water access, and feed bunk space requirements which are adequate for lactating cows are usually satisfactory for bulls.

Some bulls are housed on the dairy waiting for progeny performance information before acceptance into an AI program. Other bulls are sold specifically for natural service purposes. Bulls waiting for acceptance by an AI program are often housed in individual pens that provide adequate space for the bull to move freely (rise, stand, walk, and lie down) and provide protection from mud and rain.

The decision on construction material for pens must consider the size and strength of the bull. Many pens are

FACILITIES

constructed of pipe, although wood also is used. The pipe must be stronger than pipe used for the lactating cows. Four-inch boiler pipe is considered adequate. The best designed facilities have pipes attached to metal posts which are set in concrete for strength. The interior should be safe for the animal and attendants, with no protruding pipes or sharp edges.

As a safety factor, the bull facility design should allow attendants to feed and water the animal without entering the pen. Bull pens should be designed to allow rapid escape for the attendants if they must enter the pen. Most pens are equipped with water bowls or troughs. The surface of the pen may be dirt or concrete. Dirt pens often provide better footing, but concrete pens are also suitable if adequate bedding is provided. Concrete surfaces should not be so smooth that footing or traction is impaired or so rough that hoof bruising occurs. The bull pens should be situated so bulls can be moved safely using existing walkways or alleys. Some pens include stanchions or head gates for restraint, although these are not a necessity.

FEEDING AND NUTRITION

The feeding and nutrition programs for growing bulls should meet requirements specified in the Nutrient Requirements of Dairy Cattle (NRC, 1989) publication. Most breeding age bulls, approximately 8 months and older, are housed with lactating cows and are fed the same diets. Diets fed to lactating dairy cows (NRC, 1989) will meet or exceed the energy and nutrient requirements of the growing bull. The lactating cow diet allows for maintenance and growth as well as the increase in activity associated with breeding. Long-term access to a lactating cow diet may cause calcification of soft tissues due to the high calcium intake. This is normally not a significant concern since most bulls do not remain on the dairy long enough to reach maturity. Mature bulls should be fed diets according to the NRC (1989) recommendations. All bulls should have free access to clean, fresh water.

HEALTH CARE AND MANAGEMENT

Nose Rings

Some bulls have rings placed in their noses between 9 to 12 months of age. A self-piercing, non-rusting metal ring is inserted through the nasal septum that separates the nostrils about one inch from the tip of the nose. The procedure can be conducted by trained dairy personnel or a veterinarian. Once the nose ring is inserted, a bull staff can be used by the attendant to help control the animal.

Preventative Health Program

A preventative health program for bulls should be established in consultation with the herd veterinarian. A health program should consider deworming, particularly for bulls on pasture, routine foot trimming, and vaccination programs. Bulls should be

vaccinated for Infectious Bovine Rhinotracheitis (IBR), Bovine Viral Diarrhea (BVD), Bovine Respiratory Syncytial Virus (BRSV), leptospirosis, and vibriosis. It is a good practice to have the herd veterinarian conduct a breeding soundness examination on dairies where facilities are adequate to safely restrain the bulls. This examination includes a microscopic examination of semen quality and a physical examination for signs of testicular and other reproductive abnormalities. Bulls should also be tested for trichomoniasis at this time. Trichomoniasis and vibriosis are venereal diseases, and cows can be infected by the bull during breeding.

Most routine health care should be similar to that provided to other animals on the dairy. Attendants should observe bulls for any health problems, and appropriate action should be taken when necessary. Bulls can be aggressive, so they must be handled carefully.

Transportation

Transporting bulls requires care because of their size and temperament. Bulls are often transported individually due to their aggressive nature. Because of their size and weight, bulls that are incapable of standing require special attention. Transportation and the care of non-ambulatory or disabled animals are discussed in Section 7, and these suggestions apply to dairy bulls.

MANAGEMENT COMPONENTS

SECTION 7. CARE AND HANDLING OF ANIMALS DESTINED FOR SALE OR SLAUGHTER

INTRODUCTION

Approximately one third of all lactating dairy cattle are culled from the herd each year. Animals may be culled due to low milk production, infertility, disease, temperament, lameness, or injury. Most culled animals are destined for slaughter, but some are purchased at auctions and relocated to other farms. Animals that die on the farm are transported to a rendering facility. Some local ordinances require that carcasses destined for rendering be at least 100 feet from the roadside while awaiting pick-up. It is advisable to use "blinds," hay bales, or other barriers to keep carcasses from public view.

Transportation is inherently stressful. Regardless of whether culled animals are sold for meat or dairy purposes, every effort should be taken to minimize stress during handling and transportation. Efforts to reduce handling and transport time will reduce stress. Rough handling and animal abuse during transportation are not acceptable. Interim holding facilities, such as sale yards, should provide adequate feed, water, and shelter for the animals.

Any animals destined for slaughter, that were recently medicated, must conform to the legal meat and milk withdrawal times specified on the product label or by the veterinarian's prescription. The use of animal medications by dairy producers in a manner inconsistent with the manufacturer's or veterinarian's prescription is prohibited by law. Violative levels of any residue in the meat or other tissues of slaughter animals will result in condemnation of the carcass and penalties for the livestock owner.

ANIMAL HANDLING

Dairy cattle are generally docile. However, bulls are extremely strong and can be aggressive. Handling bulls and cows in a manner that excites or provokes them can result in serious harm to the animal and/or personnel. Cows with newborn calves may be aggressive and should be handled with caution.

Cattle have panoramic vision, except for small area directly behind them. Therefore, the animal should be approached from a direction other than the rear. If there is no alternative, a low, quiet voice will indicate to the animal that someone is approaching and will help prevent startling.

Moving animals to and from holding pens and loading ramps should be done calmly with a minimum of excitement and noise. Animals should not be forced to move faster than a walk. Whips, slappers, and other aids should

be only used if absolutely necessary, and then only by trained personnel. Devices that can cause injury should be avoided. Abusive handling only tends to make the animal more excited and prone to harming itself or others. Extremely excited animals can have elevated levels of stress hormones, such as catecholamines and cortisol, which may reduce the quality of the meat or increase susceptibility to disease. Properly designed facilities provide for ease of movement, safety for personnel, and minimum stress to the animal.

Bull calves are often sold and removed from the dairy within one day of age to be raised elsewhere for veal or beef purposes. These calves should be dry, have iodine or other approved disinfectant applied to the navel, and should have received sufficient colostrum before leaving the dairy. Humane care in handling and transport is critical to these calves since they have limited ability for self-care.

ANIMAL TRANSPORTATION

Owners or their agents have the responsibility to select and present for transportation only healthy and fit animals. Personnel involved in loading, transporting, and unloading cattle should be trained in techniques that avoid stress and trauma to the animals. Animal handling, the duration of transport, climatic conditions, and the vehicle design may all be sources of stress for cattle. Trips should be planned to minimize transport time, and avoid extreme temperatures. Both proper ventilation in hot weather and the avoidance of wind chill during cold weather are essential. In summer, trucks must be kept moving to prevent heat from building up inside the trailer. Precautions, such as shade, ventilation, and availability of water should be considered when handling and transporting animals on hot days. Animals in late gestation should be transported with extreme care to protect both the cow and fetus. Truck drivers should avoid sudden starts and stops, erratic speed, and direction changes to prevent animals from colliding and falling. Vehicles should be equipped with mirrors or inspection ports for load observation. Exhaust fumes should not enter the trailers.

The transport container should be designed for animals and be free of obstacles that could injure an animal. Doors, gates, and passageways should be designed to allow ease of passage and maintained to avoid hazards. Truck floor space should be allotted so that all animals can stand in a normal position. During long trips, the animals should be checked for signs of distress within the first 20 miles and periodically thereafter. Long trips should be planned to allow for ample consumption of feed and water. Lactating cows should be milked at 12-hour intervals.

NON-AMBULATORY ANIMALS

A non-ambulatory animal is one which is incapable of standing or

walking without assistance. These animals are often referred to as "downer cows" or "disabled" animals. Some non-ambulatory animals regain mobility with appropriate care. Others will not respond to treatment and will require euthanasia or special handling to move them to a processing facility. Some local ordinances prohibit movement of non-ambulatory animals. California Penal Code Section 599f prohibits non-federally inspected processing plants, stockyards, and auctions from buying, selling, or receiving non-ambulatory animals. It requires that non-federally inspected processing plants, stockyards, and auctions take immediate action to humanely euthanize or remove the non-ambulatory animal from the premises and prohibits the dragging or pushing of the animals.

Every dairy will occasionally have to handle animals that are acutely diseased or injured and unable to walk. Handling sick and non-ambulatory animals must be done with a minimum of force and trauma. Non-ambulatory animals should be protected from direct sunlight, rain, and extreme temperatures. Feeding, watering, and milking the animal are necessary.

Handling non-ambulatory animals requires special equipment to assure the animal is not harmed while being moved. Equipment, such as sleds and pallets, are available to safely lift and carry non-ambulatory animals to another location on the farm or to a truck for transport. If the use of chains or ropes becomes absolutely necessary to move an animal on the farm, it should be for the shortest possible distance, and padding used where a chain or rope passes over the animal's body. Without these precautions, major trauma may result.

If the proper equipment is not available, the animal should not be moved. Then either the proper equipment should be obtained, or the animal should be euthanized. Diseased or non-ambulatory animals destined for a rendering plant, must be euthanized prior to pickup. (For more detailed information see Livestock Conservation Institute, 1992.)

SALE YARDS AND SLAUGHTER-HOUSE (ABATTOIR) HANDLING

Sale yards and slaughterhouses are an essential part of the dairy business. Many animals in a sale yard are destined for slaughter; others are sold alone or in groups for transport to other dairies. The sale yard serves as a gathering place for the marketing of animals. These facilities should be designed and maintained so they do not cause injury to animals during loading, unloading, or handling. There should be no sharp edges or projections, and walkways should have non-slip surfaces. Animals should be penned according to size, age, and physical characteristics (e.g. horns). Over crowding must not occur. Solid sides on loading ramps, alleyways and in crowd pens will facilitate animal

movement.

Cattle destined for sale or slaughter should not be treated any differently than animals at the dairy. Proper care of animals destined for sale or slaughter is vital to insure the animals' future productivity or meat quality at the final destination. Abusive handling is costly for the producer. Bruises from abuse or dragging a non-ambulatory animal can reduce the carcass value up to 50 percent. Educating cattle handlers in proper animal handling practices is essential. Knowledge of basic cattle behavior including the animal's senses of sight, hearing, and smell will facilitate proper handling.

As a general rule, animals should not be without feed or water for more than 24 hours including the time spent traveling and yarding. For immature animals, the intervals should be shorter. Watering intervals should also be shorter during hot weather. Sick and diseased animals should be segregated and must not be placed in dead animal holding areas. Any terminally ill or injured animals should be euthanized without delay.

MANAGEMENT COMPONENTS

SECTION 8. EUTHANASIA OF ANIMALS ON THE DAIRY

INTRODUCTION

Occasionally it is necessary to euthanize a dairy animal due to fractures, calving complications, severe illness, or natural disasters. Under these conditions, the objective is to provide a swift and humane death, thus quickly relieving the pain and suffering of the animal. Euthanasia is the act of inducing humane death in an animal. The procedure should be done in a manner which will minimize any stress and anxiety experienced by the animal prior to unconsciousness. Stress can be minimized by proper technical proficiency of the person performing the euthanasia. Correctly done, euthanasia will minimize pain and distress in animals, assure safety of the personnel, and protect other animals and people.

When an animal is euthanized, the first step is to produce rapid unconsciousness. This is followed by respiratory and/or cardiac arrest, and ultimately the total loss of brain function. Several common methods of euthanasia are utilized on the dairy. Chemical euthanasia using injectable barbiturate may be offered by veterinarians, while the physical methods of gunshot and penetrating captive bolt gun may be performed by trained personnel.

CHEMICAL METHODS

Acceptable chemical euthanasia methods involve the intravenous injection of barbituric acid derivatives which depress the central nervous system leading to unconsciousness, respiratory and/or cardiac arrest. Only licensed veterinarians have access to barbiturate products; thus this method may have limitations in some situations. Animals euthanized by barbiturate injection should not be used for human consumption or fed to other animals, such as farm cats and dogs.

PHYSICAL METHODS

Gunshot is a physical method that is inexpensive and does not require human contact with the animal. There is potential for ricochet, so strict firearm safety must be observed. Also, local laws and ordinances may prohibit the discharge of a firearm. A .22 is sufficient for most cattle; however, large bulls require at least a .22 magnum or 9 mm round. The use of hollow-point or soft-nose bullets are recommended to increase tissue destruction and decrease ricochet. The muzzle of the firearm should be held 2 to 10 inches from the intended point of contact. The bullet should penetrate the skull at the intersection of two imaginary lines

drawn from the inside corner of the eye to a point on the top of the opposite ear (or base of opposite horn). Note, this is not centered between the eyes.

Penetrating captive bolt also kills by concussion and physical destruction of the brain. Adequate restraint is necessary to properly place the gun firmly against the animal's head at the point of impact. The bolt should enter at the same location as described for gunshot euthanasia. It is important to follow the manufacturer's recommendations on the selection of the cartridge strength appropriate for the size of the animal.

Non-penetrating captive bolt guns will stun and not kill the animal. This method must be followed by exsanguination (or another method) to assure rapid death while the animal is unconscious.

After the initial discharge of the gunshot or captive bolt gun, the animal should be exsanguinated (rapid blood loss) to ensure a swift death. To produce rapid bleed out, large blood vessels such as the carotid arteries and/or jugular veins are severed with a sharp instrument.

MONITORING VITAL SIGNS

Following euthanasia procedures, the animal will collapse and may experience a short period (less than 20 seconds) of intense muscle contraction. Poorly coordinated kicking or paddling movements and a period of relaxation will follow, and the pupils of the eyes should be fully dilated. It is important to confirm that the animal is dead y examining the vital signs of life. Death is confirmed by the lack of rhythmic breathing, heartbeat, and corneal reflex. Corneal reflex can be observed by touching the surface of the eye; no blinking or eye movement should occur. An additional euthanasia procedure may be required if there is evidence of any vital signs.

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GLOSSARY

Antibiotic	A therapeutic product produced by living organisms, such as molds, which destroys or inhibits the growth of other microorganisms, especially bacteria.
Artificial Insemination	Placing frozen semen which has been thawed in the uterus of a female bovine in estrus.
Attenuated	Process used in vaccine production to modify organisms to induce immunity without causing disease.
Brucellosis	Disease of cattle causing abortion in females and undulant fever in people. Subject to a federal/state eradication program requiring vaccination of all breeding females by an accredited veterinarian.
Bull	Uncastrated bovine male of any age.
Calf	Young bovine animal of either sex under a year of age.
Castration	Removal of the testicles.
Close-up Cow	A pregnant cow within 10 to 16 days of calving.
Coccidia	Microscopic single-celled animal parasites that cause diarrhea and other diseases.
Colostrum	Milk produced by a cow prior to and during the first milking after calving which contains maternal immunoglobulins.
Cow	A sexually mature female bovine animal which has produced a calf.
Cull	To remove less desirable animals from the breeding herd.
Dam	Female parent.
Dehorning	Procedure to remove horn or terminate horn growth permanently.
Downer Cow	Animal which cannot stand or walk due to sickness or injury.
Dry cow	Nonlactating pregnant female bovine that has completed a lactation.
Drying-off	End of lactation when milking is stopped and udder is allowed time to regenerate milk-producing tissue.
Dystocia	Difficult birth.
E. coli	Bacterium causing mastitis in cows and diarrhea in calves.
Edema	Excessive accumulation of watery fluids in cells, tissues or cavities.

Estrous Cycle	Length of time from one estrus period to the next; averages 21 days in cattle.
Estrus	The period of sexual receptivity in the cow; same as heat.
Forage	Fibrous feedstuffs harvested from plant sources (e.g., hay, silage); roughage.
Fresh	A cow or heifer that has recently given birth or "freshened."
Gestation	The time period from conception to calving.
Gossypol	A toxic compound contained in cottonseed.
Heat detection	Identification of females in heat for artificial insemination.
Heifer	A female bovine that has not produced a calf; sometimes a cow in first lactation.
Hutch	Small portable shelter for housing a single calf.
Lactation	The period between calving and drying off when a cow produces milk.
Mastitis	Inflammation of the mammary gland.
Milk fever	See parturient paresis.
Morbidity	Incidence of disease; morbidity rate is the proportion or percentage of individuals in a group that become ill during a specified time.
Mortality rate	Proportion or percentage of individuals that die from a disease during a specified time, usually 1 year.
Mycotoxin	Poisons in feed caused by molds.
Natural Service	Breeding of a cow utilizing a bull rather than artificial insemination.
Necropsy	Post-mortem examination performed on animals.
Ovary	The female reproductive gland in which the eggs are formed and progesterone and estrogenic hormones are produced.
Parasite	An organism that lives a portion of its life cycle in or on a host animal.
Parturient paresis	Partial paralysis that occurs at or near time of giving birth to young and beginning lactation; commonly called milk fever.
Parturition	The process of giving birth, calving.
Pasteurization	The process of heating milk to 161^{o}F and holding it at that temperature for 15 seconds to destroy microorganisms that cause disease or spoilage of products.
Pathogen	Biologic agent--i.e., bacteria, virus, protozoa, nematode--which produces disease or illness.
Periparturient	The time around calving.

Periparturient hypocalcemia	Low serum calcium associated with calving which can result in loss of motor function. (See also parturient paresis.)
Postpartum	Following birth.
Protozoa	Single-celled microscopic animals.
Rumen	The large fermentation compartment of the ruminant animal's stomach in which bacteria and protozoa break down fibrous plant material and other feedstuffs, and synthesize essential proteins and vitamins.
Rumination	Regurgitation and chewing of feed from the rumen; cud chewing.
Shade	Structures in corrals designed to provide shelter from sun.
Stanchion	Devices that close around the neck of cattle behind the head; used to restrain animals for heat detection, examination, breeding, treatment, etc.
Stress	An unusual or abnormal influence causing a change in an animal's function, structure, or behavior.
Total Mixed Ration (TMR)	Complete ration consisting of concentrate, roughage, and supplements necessary to meet the daily nutrient and energy nutritional requirements of the cow or heifer.
Vaccine	Suspension of attenuated or killed microbes or toxins administered to induce active immunity.
Whole milk	Milk as collected from the cow.

INDEX