

Reference Point

A review of the causes, prevention, and welfare of nonambulatory cattle

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A major animal welfare issue facing the livestock industry is the care, handling, and transport of nonambulatory cattle. Consumers, researchers, practitioners, and animal protection organizations have questioned the quality of care provided to and management of nonambulatory cattle and raised questions about possible food safety concerns. Veterinarians and producers continue to be challenged with providing quality care for nonambulatory cattle. In addition, veterinarians are recognized as a credible source of information for consumers, regulators, and policy makers. Thus, it would be beneficial to provide peer-reviewed information to practitioners and others who must make clinical and policy decisions.

Several sources^{a-f} were searched by use of various key words to identify relevant peer-reviewed citations for the information reported here. In addition, governmental and lay reports were reviewed to ascertain policies, regulations, and historical data concerning nonambulatory cattle. Existing peer-reviewed information was considered adequate by the authors for the development of recommended on-farm management practices that could result in a decrease in the incidence of, an improvement in the prognosis for, and a benefit to the well-being of nonambulatory cattle.

Definition of Nonambulatory or Downer Cows

Wide variation exists in the case definition and related terms applied to nonambulatory cattle. The colloquial term downer has been used since the 1950s to describe cattle that are too injured, weak, or sick to stand and walk.¹ The term creeper has been used to describe cattle that are unable to use their hind limbs but that could propel themselves short distances with their forelimbs.² More recently, the term downer has commonly denoted cattle that are unable to stand after 24 hours of recumbency but that can maintain sternal recumbency.³ Such cattle are sometimes referred to as alert downers to differentiate them from lethargic or moribund recumbent cattle that are unable to stand. The inclusion criteria

ABBREVIATION

BSE Bovine spongiform encephalopathy

used to define cattle as nonambulatory are critically important when making comparisons among scientific studies, particularly when examining incidence rates and prognosis.

Incidence of Nonambulatory Cattle

The incidence of nonambulatory cattle in the United States has been estimated in a number of surveys conducted by industry, academia, and the government. Assessments of culled cattle in holding pens at 21 slaughter facilities throughout the United States provided estimated overall incidences of 1.15%⁴ and 0.8%⁵ for nonambulatory cattle during 1994 and 1999, respectively. Based on estimates of the number of nonfed cattle slaughtered at federally inspected facilities, 71,117 and 49,520 cattle were nonambulatory at processing plants during 1994 and 1999, respectively. Estimated incidences in those reports were between 1.1% and 1.5% for nonambulatory dairy cows and 0.7% and 1.1% for nonambulatory beef cattle.

In 2001, 7,382 nonambulatory fed and nonfed cattle arrived at 19 slaughter facilities in Canada.⁶ Approximately 90% of the nonambulatory cattle were dairy breeds, and 10% were beef breeds. Interestingly, the nonambulatory condition reportedly originated during the transport process in < 1% of the affected cattle; thus, the nonambulatory condition originated in most cattle while they were still on a farm.

Surveys of nonambulatory cattle sent for slaughter may not accurately represent the on-farm incidence of the condition. Slaughter facility data may overestimate the rate of nonambulatory cattle because such cattle are preferentially marketed. Conversely, slaughter data may underestimate the on-farm rate because of failure to capture the number of cattle that were treated and recovered or that were euthanized on the farm. The proportion of cattle that were treated and recovered may be considerable in the case of dairy cattle with periparturient hypocalcemia.

In a governmental study⁷ in which questionnaires were mailed to dairy producers in 21 states, it was reported that 78.2% of the dairy operations had had nonambulatory cows during 2004. Total numbers of dairy and beef cattle (adults and calves) on US farms that were

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unable to stand or walk for any reason at any time during the year were reported to be 465,000 (0.40%) and 450,000 (0.38%) for the years 2003 and 2004, respectively. Analysis of these numbers suggests that during any given year, the number of nonambulatory cattle in the United States may approach 500,000.⁸ These numbers do not specify the proportion of cattle that recover versus the proportion of permanently nonambulatory cattle. Compared with the 1994⁴ and 1999⁵ estimates of approximately 50,000 to 70,000 nonambulatory cattle sent to federally inspected slaughter facilities, this suggests that a large proportion of nonambulatory cattle recovered, died, or were euthanized on the farm.

Perhaps the most complete description of on-farm incidence of nonambulatory dairy cattle was an evaluation in 1986 of 738 Minnesota dairy herds representing 34,656 cow-years at risk. In that investigation, a case definition of a cow recumbent on its sternum for > 24 hours for no obvious reason was used, and overall annual incidence ranged from 0.4% to 2.1%.^{9,10} Differences in reported incidences may be attributable to differences in herd health and management among dairies.

Regulatory History

On May 3, 1993, a news broadcast in Los Angeles provided graphic footage of nonambulatory cows being moved on the tines of a fork lift at a single slaughter facility. This served as the impetus for legislative efforts, and legislation to address the transport, handling, and slaughter of nonambulatory cattle for human consumption was passed in California in 1994.¹¹ That law regulates slaughterhouses not inspected by the USDA as well as stockyards and auction markets. The regulation prohibits the buying, selling, or receiving of a nonambulatory animal and makes it unlawful to drag or push with equipment a nonambulatory animal while in transit or on the premises of a stockyard, auction, market agency, livestock dealer, or slaughterhouse. Equipment that may be used to move nonambulatory animals is restricted to a sling, stone boat, or other sled-like or wheeled conveyance. A violation of the Downed Animal Law of California is a misdemeanor.

Colorado, Illinois, Oregon, and Washington have adopted similar legislation. A series of federal bills failed to pass after being referred to committee. The federal bills were introduced between 1999 and 2003 and would have made it unlawful for a stockyard owner, market agency, or livestock dealer to transfer or market nonambulatory cattle, sheep, swine, horses, mules, or goats.

The most profound change in US regulation of nonambulatory cattle came after the first case of BSE was diagnosed in the United States on December 23, 2003. The infected animal, a dairy cow imported from Canada to a farm in Washington, focused public and regulatory attention on the practice of including nonambulatory cattle in the human food supply. Seven days after the initial case of BSE was reported, the Secretary of Agriculture announced an immediate ban on all slaughter of nonambulatory cattle for human consumption. The published interim rule¹² defined nonambulatory, disabled livestock as animals that cannot rise from a recumbent position or that cannot walk, including but

not limited to those with broken appendages, severed tendons or ligaments, nerve paralysis, a fractured vertebral column, or metabolic conditions. The provisions in this definition have been contested by some livestock industry groups on the grounds that the definition may include nonambulatory cattle that are not BSE suspects and that could still be suitable for human consumption; thus, their exclusion could cause a detrimental economic impact to producers.

Many countries, including Australia, New Zealand, Canada, and member countries of the European Union, have policies to prohibit the transport of nonambulatory animals (**Appendix 1**).¹³⁻¹⁷ Similarly, the World Organization for Animal Health (Office International des Epizooties, an animal health coalition of 164 countries) has established standards¹⁸ regarding livestock transport by land. Those standards specify that each animal should be inspected by a veterinarian or animal handler to assess fitness to travel. Animals found unfit to travel should not be loaded onto a vehicle, except for transport to receive veterinary treatment. Animals that are unfit to travel include those that are unable to stand unaided and to bear weight on each limb. These and similar policies may become future trade barriers for members of the Office International des Epizooties or trading partners who are unwilling to comply.

Other Policies on Disabled Livestock

The AVMA recently revised its policy on ambulatory and nonambulatory disabled animals. The current policy, which was approved in 2006,¹⁹ is that at no time should a nonambulatory animal be dragged. The policy maintains that when there are nonambulatory cattle on a farm, producers should contact a veterinarian for assistance if the animal is not in extreme distress and continues to eat and drink. Nonambulatory animals that are in extreme distress and have an obviously irreversible condition should be immediately euthanized or humanely slaughtered (state laws permitting) on the farm.

Negative publicity, particularly when related to slaughter procedures and BSE, has raised concerns among retail food companies about the humane treatment of nonambulatory cattle and the safety of products derived from them. The Food Marketing Institute and National Council of Chain Restaurants have collaboratively developed an animal welfare program for their members, who include food retailers, wholesalers, and chain restaurants. The program endorses the AVMA's policy on the handling of disabled livestock and emphasizes that under no circumstance should a disabled animal be moved by dragging or otherwise pulling on its limbs or extremities.²⁰ Since 2002, a number of retail restaurant chains, including McDonald's, Wendy's, and Burger King, have prohibited suppliers from obtaining products derived from nonambulatory cattle.

Food Safety of Beef Products Obtained from Nonambulatory Cattle

The issue of food safety of nonambulatory cattle suspected to have BSE was the basis and platform for the development of the federal interim rule. Although

nonambulatory cattle have been banned from the human food supply since 2003, data on food safety of beef products from nonambulatory cattle are limited. In a study in Canada,⁶ there was a carcass condemnation rate of 37% for nonambulatory dairy cattle arriving at 19 slaughter facilities. The prevalence of *Escherichia coli* O157:H7 in fecal or tissue samples from nonambulatory dairy cattle (4.9%) was 3.3 times that in ambulatory cattle (1.5%).²¹ In another study,²² 6 of 20 nonambulatory cattle sent to a slaughter facility were identified as fecal shedders of *Salmonella* spp. Conversely, nonambulatory cattle did not have a higher incidence of positive results for antimicrobial residue tests than did randomly tested ambulatory cattle.²³ Although we are not aware of any published research data on specific factors that affect the quality of meat obtained from carcasses of nonambulatory cattle, it is reasonable to assume that the number and severity of bruises caused by the pressure of their own body weight resulting from being in a recumbent position for even a few hours, along with any bruises or injuries caused by the handling and transporting of these cattle, would cause excessive trimming of the carcasses and compromise meat quality.

Signs of progressive or nonprogressive neurologic conditions (including persistent recumbency) are consistent with BSE.²⁴ In countries with a high prevalence of BSE, nonambulatory cattle could represent a greater risk of BSE infection. However, in the United States, the risk of a cow contracting BSE is extremely low. During the past 7 years, samples have been obtained by the USDA from > 735,000 cattle, which has allowed the USDA to estimate a BSE prevalence of < 1 in 1 million cattle.²⁵ Of the 2 indigenous US cattle in which BSE was diagnosed, 1 had a history of being nonambulatory. The USDA's updated Harvard Risk Assessment evaluated the impact of risk management measures that have been or could be adapted to control BSE in the United States. Removal of nonambulatory cattle from the human food supply was estimated to reduce human exposure to BSE-contaminated material by approximately 3%.²⁶

Causes and Diagnosis

Numerous reasons exist for cattle to lose the ability to stand and walk. The causes of pathologic recumbency can be divided into general categories, including injuries, metabolic derangements, and infectious or toxic diseases. A detailed discussion of these conditions can be found elsewhere.²⁷⁻³² Most nonambulatory cattle are of dairy origin. The condition occurs most often within 1 day of parturition and frequently results from periparturient hypocalcemia or complications associated with calving.^{3,29,33} In 1 study,³³ investigators evaluated risk factors for downer cow syndrome in dairy cattle for the 30 days after parturition in 12 Holstein dairy herds in New York. Clinical hypocalcemia (odds ratio, 5.6), stillbirth (odds ratio, 4.9), and dystocia or retained fetal membranes (odds ratios, 5.7 to 6.1) were all risk factors for recumbency. In another study,⁷ the 3 major causes for nonambulatory cattle identified by dairy producers located in 21 states in 2004 were hypocalcemia (19%), calving-related injuries (22%), and injuries resulting from slipping and falling (15%). In beef cattle,

the primary cause of nonambulatory cattle is calving paralysis.³

Secondary recumbency is a condition in which a nonambulatory animal has pressure damage to muscle and nerve tissue, which results in prolonged or permanent recumbency.^{18,34} Compartmentalization syndrome (a human medical condition) is an associated pathologic diagnosis in which increased tissue pressure in a confined anatomic space causes decreased blood flow that leads to ischemia and dysfunction of contained myoneural elements. Crush syndrome (another human medical condition) is used to denote the systemic effects of muscle damage, including renal damage, cardiac arrhythmias from hyperkalemia, and increased activity of creatine kinase.³⁵ Clinical complications can develop extremely rapidly in cattle that develop secondary recumbency. In a study³⁵ in which 16 cows were anesthetized for 6 to 12 hours, only 8 could stand unassisted within 3 hours after cessation of anesthesia. The remaining 8 cattle ceased attempts to stand and remained recumbent (usually sternal recumbency) until they died or were euthanized. The hind limb positioned underneath the body in each of these 8 cattle became rigid and swollen, and cattle voided dark-brown urine indicative of myoglobinuria. Necropsy revealed that the proximal portion of the thigh of affected limbs had extensive damage to the sciatic nerve and pale, necrotic, fetid muscle. Thus, during a period of recumbency with a duration of only 6 to 12 hours, pathologic changes can develop that compromise the success of nonambulatory cattle to subsequently stand and recover.

Prognosis

The wide array of primary causes and the range in severity of secondary nerve and muscle damage make it challenging to provide a prognosis for nonambulatory cattle. A careful medical history and physical examination will greatly assist in the effort. Physical examination of nonambulatory cattle should include assessing the animal for signs of metabolic or infectious disease, musculoskeletal injuries or accidents, neurologic conditions, and other causes. Results of physical examination will aid in making a diagnosis, but it is difficult to perform a thorough physical examination in recumbent cattle.³⁶ Clinical assessment of limb strength and peripheral nerve function and transrectal palpation are aided by elevating the patient with hip clamps or a sling.

When the primary cause of recumbency lends itself to treatment (eg, hypocalcemia, calving paresis, and acetonemia [ketosis]), then the duration of recumbency and quality of nursing care become critical prognostic information. In a study³⁷ of 84 hypocalcemic cows treated within 6 hours after becoming recumbent, 83 (98.8%) became ambulatory. Another researcher suggested³⁴ that 6 hours is the threshold for the induction of secondary recumbency in anesthetized cows. Dairy producers who responded to a questionnaire indicated that approximately half of the nonambulatory cattle that recover and remain in the herd were nonambulatory for < 6 hours. Thus, dairy cattle that have been nonambulatory for > 6 hours are considered to have a poor prognosis.⁷

The quality of nursing care will also affect prognosis.²⁸ A study³⁸ of 64 nonambulatory cows in the United Kingdom revealed that the single best prognostic indicator was the quality of nursing care, compared with other factors such as bedding provisions, attitude, attempting to stand, body condition, environment, and clinical blood variables.

Some physical examination findings and diagnoses immediately suggest a guarded to poor prognosis. Fractures, luxations of the hip joint, abscess or metastatic neoplasia of a vertebral body, inoperable gastrointestinal tract disease, and gangrenous mastitis are conditions for which further expenditures for treatment and nursing care are unlikely to be efficacious. Limbs that are rigid, swollen, or lacking sensation are suggestive of muscle or nerve damage. Cattle with fractures or hip joint luxations have a poor prognosis. It can be difficult to diagnose fractures in nonambulatory cattle in on-farm settings. Crepitus may be masked by muscle mass over the femur, and diagnosis of fractures is often presumed on the basis of limb placement and mobility. Hip joint luxation in adult cattle has a poor prognosis, but treatment can be attempted by open or closed reduction techniques.³⁹

For a number of enzymes, serum activity is greater in nonambulatory cattle than in healthy control cattle.^{40,41} In 1 experiment,³⁴ mean activity of serum creatine kinase, a specific indicator of muscle damage, was greater and peaked later in permanently nonambulatory cattle, compared with cattle that recovered. A single measurement of creatine kinase activity is not useful because of variability among animals and a lack of association between creatine kinase activity and duration of recumbency.²⁸ Clinical pathology data have limited diagnostic or prognostic value for individual animals.^{28,39}

Treatment and Management of Nonambulatory Cattle

Because secondary muscle and nerve damage may develop rapidly following the onset of recumbency and greatly reduce the likelihood of recovery, nonambulatory cows should be treated as medical emergencies. Obtaining a complete medical history and conducting a thorough physical examination prior to treatment will be helpful in reducing animal discomfort and costs associated with treating and nursing patients with a poor prognosis. A prompt decision should be made after careful consideration of the extent and duration of pain, likelihood of successful outcome, availability and cost of treatment and nursing care, and value of the animal. When evaluation of these factors indicates that a clinician should not initiate treatment, then the animal should be euthanized.

Treatment and care of nonambulatory cattle should have 2 goals: to correct the primary cause of recumbency and to minimize secondary nerve and muscle damage. Nonambulatory cattle should be placed in an area to provide shelter from precipitation and sun and that is secure from predators. Ambulatory cattle and other animals should be segregated from nonambulatory cattle to reduce trauma and allow the nonambulatory cattle to be able to eat and drink. When nonambulatory cattle require relocation for additional treatment and

care, movement should be performed in an appropriate and humane manner. Cattle can be gently rolled onto sleds or carefully placed into large front-end loaders for transport.⁴² To prevent further injury, stress, and pain-inducing trauma, nonambulatory cattle should never be dragged.

To minimize secondary nerve and muscle damage, nonambulatory cattle should be placed on a soft surface that provides adequate traction. Various bedding materials can be used to provide a soft, clean, dry, non-slip surface. Twelve inches of sand bedding can be used to improve the likelihood of recovery and decrease the development of decubital sores and urine scalding.^{43,44} Sand also facilitates examination and care of recumbent cows while providing traction for secure footing and easy removal of manure.

Nonambulatory cattle should be maintained in sternal recumbency. Cattle in lateral recumbency become bloated when rumen contents obstruct the esophageal hiatus. When necessary, hay bales can be used to assist in maintaining cattle in sternal recumbency. Recumbent cattle should be repositioned every few hours, alternating between left- and right-sided sternal recumbency, to prevent secondary, permanent ischemic muscle necrosis and nerve damage to the compressed hind limb that is located under the body of the recumbent animal.^{45,46} Caretakers must ensure that water and feed are easily accessible to nonambulatory cattle at all times. Containers should be secured to prevent spillage.

Another option for minimizing the effects of pressure damage to nonambulatory cattle is the use of commercially available lifting devices. The use of hip clamps, airbags, slings, and flotation tanks to assist in the diagnosis, management, and treatment of nonambulatory cattle has been described.^{28,47} Lifting a recumbent animal immediately reduces tissue pressure in the compressed hind limb.²⁸ Often, a nonambulatory animal needs some assistance to stand; circulation will return to an affected limb once the animal is standing. Devices such as hip clamps and slings can be beneficial if used carefully by competent and trained personnel.²⁸

Hip clamps are potentially dangerous lifting devices because support of a large amount of an animal's weight is transferred to the region around the tuber coxae.²⁹ It is best that, when used, hip clamps are applied to cattle that can stand and bear weight once in a standing position; however, under no circumstances should an animal be left unattended in one of these devices.⁴³ Use of well-padded hip clamps may be tolerated for 10 to 15 minutes twice daily for several weeks. Hip clamps may be tolerated better when suspended over the cow from a stabilizing cart surrounding the animal and combined with the use of a sternal support band, both contributing to lessening potential tissue hip damage and pain from the hip clamps.⁴³

Single belly-band slings and air bags are ineffective for use in nonambulatory cattle because they compress the abdomen and compromise respiration. Innovations in sling design with numerous adjustable straps providing support to the thoracic (ie, brisket) and inguinal areas have allowed for the safe support of nonambulatory cattle for extended periods.²⁸ Ideally, slings should be used to lift a recumbent animal to a standing position

to enable the animal to bear at least some weight on its limbs for up to a few hours; the animal should then be returned to sternal recumbency. The process should be repeated several times each day to relieve pressure and prevent damage to muscles and nerves.

Flotation tanks use water to gently lift nonambulatory cattle to a standing position, thus minimizing pressure damage that could result from the use of other lifting devices. Careful screening of candidates should be conducted to eliminate nonambulatory cattle that have a poor prognosis (eg, fractures, illness, and spinal cord injuries), which will greatly increase the likelihood that flotation will result in recovery.⁴⁷ A typical flotation system involves positioning a recumbent animal on a rubber mat, moving the animal into a watertight tank (or box), and filling the tank with warm water. The tank should be filled with water as quickly as possible to minimize struggling by the animal.²⁹ It is important that the water temperature be maintained close to that of the animal through repeated additions of warm water or use of a bath heater. Cattle typically can remain in a filled flotation tank for 6 to 8 hours, but durations in the flotation tank of up to 24 hours are possible. It may be necessary to repeat flotation sessions daily for up to 10 days to enable affected cattle to recover and stand unassisted.⁴⁸ Successful recovery rates range from 44% in 1 study⁴⁹ to 90% when candidates for flotation were carefully screened for selection in another study.⁴⁷

Nonambulatory cattle should be evaluated daily to assess their ability to stand or bear weight. It is often helpful to assist an animal during its attempts to stand; this can often be accomplished by lifting at the base of the tail.

Nerve and muscle function can be assessed on nonambulatory cattle by pinching the skin between the claws of the hooves with fingers or hemostats; alternatively, as a last resort, an electric prod can be used in a judicious manner.⁵⁰ Repetitive use of an electric prod must be avoided; a clinician should be able to determine during the initial 1 or 2 attempts whether an animal is able to stand. Application of hobbles may assist in preventing excessive abduction of the hind limbs in weak cattle.³⁶

Medical treatment should address hydration status, inflammation, infection, and metabolic derangements. Cattle that cannot maintain hydration should be treated by IV or oral administration of fluids. Anti-inflammatory drugs may minimize tissue damage, inflammation from trauma, and effects of endotoxemia.⁵¹ Corticosteroids that currently are available and labeled for treatment of pain or inflammation in cattle include dexamethasone, which has no labeled withdrawal period for milk or slaughter, and isoflupredone acetate, which has no labeled withdrawal period for milk but a 7-day withdrawal period for slaughter. The nonsteroidal anti-inflammatory drug flunixin meglumine has 36-hour and 4-day withdrawal periods for milk and slaughter, respectively. Flunixin meglumine should be used only in accordance with label directions (ie, IV administration) in cattle because IM or SC routes of administration can result in violative tissue residues.^{52,53}

Euthanasia

Veterinarians should assist owners in making appropriate decisions to euthanize nonambulatory cattle. These decisions should be made in a timely manner and should involve use of appropriate techniques that ensure death of the animal. Cattle with signs of severe and uncontrollable pain or extreme discomfort or that have a poor prognosis (as described previously) should be euthanized immediately. Extreme physical discomfort has been described as the product and duration of pain.⁵⁴ Signs of acute pain in nonambulatory cattle include recumbency, guarding an affected body part, swollen or obviously fractured limbs, vocalization or attempts to vocalize, labored breathing, bruxism, and decreased food intake.⁵⁵ Appropriate methods for euthanasia of cattle include captive bolt, gunshot, or euthanasia solution.⁵⁶ Euthanasia must be performed by a veterinarian or, where allowed, by trained personnel. Use of IV administration of barbiturate-containing euthanasia solutions may be limited in certain areas because of regulations or policies established by rendering companies. Carcasses must be disposed of promptly and appropriately, taking into consideration local environmental regulations and availability of rendering services. Methods of carcass disposal include rendering, burial, burning, anaerobic digestion, and composting. When an injectable euthanasia solution is used, scavenging animals should be prevented from having access to a carcass because of possible residues of the euthanasia solution.

Prevention

In 1 study,⁵⁷ nonambulatory dairy cattle were 3.5 times as likely to be culled from the herd as were lactating cattle without disease. Furthermore, cattle were frequently culled near the beginning of lactation, resulting in costly losses in milk production. Thus, the periparturient period is a critical time for cattle. One of the primary goals of bovine practitioners should be to assist owners with cattle management to prevent nonambulatory cattle. Veterinarians may make recommendations in several areas, including appropriate nutrition, herd health and breeding programs, cow comfort, sanitation, and calving procedures and facilities (**Appendix 2**). The leading risk factors for recumbency in cattle are hypocalcemia, complications associated with calving, and injuries.^{7,33} Therefore, periparturient cattle should be closely observed, although monitoring by remote video cameras may be a suitable option.³⁴ Trained, responsible personnel should be available to promptly provide assistance. Detailed reviews⁵⁸⁻⁶¹ for the prevention of periparturient paresis and obstetric complications are available and may be of assistance when developing strategies for commercial producers. Minimizing lameness in dairy and beef cattle will contribute to the prevention of nonambulatory cattle. Careful and quiet handling along with facilities that provide safe, nonslip surfaces will assist in preventing injuries and falls, which is especially important for periparturient cows.⁶²

Conclusions

The exact number of nonambulatory cattle on US farms or feedlots or sent to slaughter facilities is difficult to ascertain, but estimates may approach 500,000 animals/y. The incidence of nonambulatory cattle is greater among dairy than among beef breeds. Regulations and policies on transport of nonambulatory cattle and their inclusion in the human food supply have been developed on the state, national, and international level. There are limited data on the food safety of beef produced from nonambulatory cattle sent to slaughter facilities. However, the prevalence of *E coli* O157:H7 was greater in nonambulatory than in ambulatory dairy cattle in 1 study.²¹ Analysis of the literature supports the practice of treating nonambulatory cattle as medical emergencies because secondary muscle and nerve damage develop rapidly following the onset of recumbency and reduces the likelihood of recovery. Dairy cattle that have been nonambulatory for 6 hours or more have a poor prognosis for recovery and remaining in the herd. Most nonambulatory dairy cattle are the result of periparturient hypocalcemia or complications associated with calving; thus, the periparturient period is a critical period. Conducting a thorough physical examination prior to treatment will be helpful in avoiding costs associated with treating and nursing patients that have a poor prognosis. Treatment of nonambulatory cattle is complicated by the difficulty of making an accurate diagnosis of primary and secondary problems. All decisions on medical treatment should take into consideration pain management, prognosis, withdrawal times, and final disposition of the animal. Quality of nursing care is a major determinant for successful recovery. At the least, cattle should be moved by use of a method that minimizes pain and discomfort; placed on soft, deep bedding; provided with access to feed and water; and repositioned every few hours, alternating between left- and right-sided sternal recumbency. Use of one of the various lifting methods will probably increase the likelihood of recovery, assuming the primary cause of recumbency can be successfully treated. Veterinarians can assist producers in adopting prevention and treatment practices for nonambulatory cattle. Euthanasia should not be delayed in cattle for which there is no hope of improvement or that have a poor prognosis.

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Appendix 1

Regulations for transport of nonambulatory animals in various countries.

Country	Regulation
Australia	Prohibits transport of nonambulatory livestock to slaughter in all states and territories.
Canada	Prohibits loading or transport of compromised animals that cannot be transported without undue suffering during the expected journey. ¹³ Nonambulatory animals cannot be transported, except to a veterinarian for diagnosis and treatment or to receive proper care and attention. ^{14,15}
Members of the European Union	Animals that are injured or that have physiologic weakness or pathologic processes shall not be considered fit for transport and, in particular, if they are unable to move independently without pain or to walk unassisted. ¹⁶
New Zealand	Animals must be able to stand and bear weight on all limbs and be sufficiently fit to be able to withstand the journey without suffering unnecessary pain or distress. To bear weight means that the animal must be able to support weight on all limbs to stabilize itself during transport. ¹⁷ Any animal with a broken limb must not be transported for slaughter. An animal with a broken limb must not be transported for any reason unless it has been treated by a veterinarian. ¹⁷

Continued on next page.

Appendix 2

Management procedures for the prevention and treatment of nonambulatory cattle.

Nutrition

Diets of nonlactating and periparturient cows should be balanced, especially for all macrominerals, to minimize the incidence of hypocalcemia and acetonemia (ketosis). Veterinarians should consider analysis of forage mineral content and consultation with a professional nutritionist for herds with a high prevalence of these conditions.

Body condition of heifers and cows should be evaluated because excessive condition (ie, fat) contributes to hepatic lipidosis and parturition problems. Dairy heifers should achieve 65% of mature weight by first breeding and 85% of mature weight with a body condition score of 3.5 (scale of 1 to 5) by first parturition.

Herd Health

Veterinarians should provide a prompt diagnosis and prognosis for cattle that are injured, sick, or nonambulatory.

Nonambulatory cattle should be treated as medical emergencies. Cattle that are nonambulatory for 6 hours or more are considered to have a poor prognosis.

High-quality nursing care should be provided to nonambulatory cattle. Nonambulatory cattle should be maintained in sternal recumbency and repositioned every few hours, alternating between left- and right-sided sternal recumbency.

Lifting devices (eg, well-padded hip clamps, slings, or flotation tanks) and hobbles should be readily available to assist with nonambulatory cattle. Personnel should be trained and competent in the use of lifting devices or hobbles.

Common mastitis control methods should be implemented, including teat sanitation; teat dipping; evaluation of milking machines for proper function; and, possibly, the use of vaccines to prevent or minimize the effects of mastitis. Bedding for lactating and nonlactating cows should be clean and dry to help prevent exposure to mastitis-causing pathogens.

A hoof health program should be instituted that consists of routine hoof evaluation and trimming procedures, use of antiseptic footbaths to prevent infectious foot diseases, and frequent observation for early detection of hoof and limb disorders.

High-risk cattle should be culled from the herd before they become nonambulatory. This may include cattle with a history of metabolic disorders or lameness, older cattle, cattle with poor temperament, and cattle in poor body condition.

Plans for euthanasia of cattle should be developed and implemented. Cattle with signs of severe and uncontrollable pain or that have a poor prognosis should be euthanatized immediately. Euthanasia must be performed by a veterinarian or, where allowed, trained personnel.

Cow Comfort

Cattle should be handled quietly and gently to prevent injuries and falls.

All facilities, dry lots, and pastures should be maintained to provide safe conditions; areas that may cause or result in injuries or slipping should be repaired immediately.

Safe footing should be provided for cattle. Concrete floors should be grooved to prevent slipping and falls. Rubber floor mats also may be used to provide secure footing in high-traffic areas.

Clean and dry housing should be provided for lactating and nonlactating cows.

Sick, injured, and nonambulatory cattle should be provided with clean bedding, suitable ventilation, access to feed and water, and adequate shelter from precipitation and sun.

Nonambulatory cattle should be separated from ambulatory cattle and other animals to reduce trauma and allow the nonambulatory cattle to be able to eat and drink.

Nonambulatory cattle should be placed on a soft surface that provides adequate traction, such as sand or other deep bedding, to minimize secondary nerve and muscle damage.

Calving procedures and facilities

Heifers should be bred to calving-ease sires to reduce the risk of dystocia.

The calving area should be clean and dry, have adequate lighting, and provide good traction for safe footing. The calving area should allow for close observation of periparturient cattle.

Trained, responsible personnel should be available to provide frequent and careful monitoring of periparturient cows for dystocia and evidence of metabolic disorders.

Necessary treatment for nonambulatory cattle should be promptly provided. Personnel should be educated on proper obstetric techniques as well as when to call a veterinarian for assistance.