45 Beef Quality Assurance

Bob LeValley; Rosslyn Biggs, DVM and Barry Whitworth, DVM

Objectives

- **Define the purpose of beef quality assurance.**
- **Identify specific quality challenges within the beef industry.**
- **Outline beef quality assurance guidelines.**

History and Mission of Beef Quality Assurance

The Beef Quality Assurance (BQA) program was first implemented in 1982 by producers and the United States Department of Agriculture Food Safety Inspection Service (USDA-FSIS). The purpose was to avoid violative drug residues in beef. Since that time, the BQA program has been expanded to include other factors influencing overall beef quality (Figure 45.1). The BQA principles are similar to those developed by Pillsbury for the quality control program for supplying food to the NASA space program. Their program, the Hazard Analysis Critical Control Point Program (HACCP), gained USDA acceptance and is presently the outline for quality assurance programs in packing houses and processing facilities. Using HACCP, control points have been identified in the beef production system, through which producers can implement management practices to improve and prevent potential hazards, while securing food safety and quality (Table 45.1).

Through the efforts of the American Association of Bovine Practitioners and national and state cattlemen's associations, "Key Practices" have been established (Figure 45.2). The objective of the Oklahoma BQA program is to educate cattle producers and other industry professionals regarding the BQA guidelines and to encourage the adoption of BQA principles. The overall goal of the Oklahoma BQA program is to improve beef quality characteristics by minimizing the occurrence of violative residues, pathogen contamination and carcass defects and by improving carcass leanness, cutability and palatability. The Oklahoma BQA program is a cooperative effort between beef producers, the Oklahoma Beef Council, OSU Extension and other industry groups. The BQA program acts as a catalyst to encourage use of the latest science and technology to meet expectations about beef quality and safety.

Figure 45.1. The BQA Program is intended to maximize consumer confidence concerning beef.

Industry Quality Challenges – Quality Audits

The importance of BQA can be seen when reviewing the top-quality defects identified in a series of National Beef Quality Audits (Table 45.1). These audits were intended to document carcass characteristics and defects in the cattle harvested and processed for beef in the U.S. To date, six audits have been conducted (1991, 1995, 2000, 2005, 2011 and 2016) surveying cattle that had been fed high-grain diets in feed yards prior to harvest. These audits are referred to as

All Web addresses given in this chapter are subject to change. The links to these websites will be updated regularly at the Master Cattleman website at extension.okstate.edu/programs/master-cattleman.html

Table 45.1. Examples of control points impacting the BQA program.

Process	*Control point*	*Potential quality concerns*
Breeding and genetics	Planned breeding system Sire selection Replacement female selection Culling	Carcass characteristics Health Performance Temperament
Herd health and cattle handling	Processing cows and calves: at branding at weaning Receiving breeding cattle Receiving and processing stocker cattle Shipping cattle	Bruises Drug residues Injection site lesions Carcass characteristics Health Temperament Dark cutters
Transportation	Trailer design and size	Cattle injury Driving techniques Bruising, injury Cattle handling during loading/unloading Dark Cutters Biosecurity Health
Parasite control	Internal parasite control External parasite control	Injection site lesions Withdrawal times Performance Hide damage
Nutrition and grazing management	Herbicide application Blending feed Purchasing feed	Drug residues Feed additives Ruminant derived protein Thin cows
Culling management	Timely marketing Shipping culls	Carcass characteristics Bruising Condemnation Downer cows Health

fed-cattle or fed-beef audits. Additionally, four market cow and bull quality audits have been conducted (1994, 1999, 2007 and 2016) to represent average characteristics and defects of nonfed sources of beef.

Fed-Cattle Quality Audits

To assess the current quality and consistency status of U.S. fed steers and heifers, university researchers evaluated about 8,000 (Navigating Pathways to Success, Beef Quality Audit, 2016) live cattle for attributes related to transportation and mobility, and about 25,000 carcasses on the slaughter floor for characteristics that can affect quality and value of cattle, carcasses and byproducts. This research was conducted at 17 U.S. beef processing facilities. Researchers also studied 9,106 carcasses in 30 processing facilities to assess various characteristics that determine quality and value, including quality and yield grade, weight and marbling. These assessments represented about 10% of a day's production at each plant. Comparing data from 2016 to the previous five surveys assesses progress in improving quality, while providing a benchmark for future beef industry educational and research efforts.

Several of the quality indicators have changed with time. For example, the percentage of fed cattle with horns has declined substantially since 1995. Likely, the majority of this improvement is due to trends in breed selection among producers (more polled cattle), while it is also possible more producers are dehorning cattle compared to previous years.

The frequency of hide defects due to branding has decreased, but bruising has slightly increased. The good news is the 2016 audit reported 77% of the bruises were classed as minimal in severity. Minimal classification means that less than one pound of surface trimming is required.

The incidence of dark cutters has declined since the 1991 audit and continues to range from 1.9% to 3.2% since the 1995 audit. Of particular concern, liver condemnations were substantially greater in the 2016 audit compared to 2011 while the frequency of lung condemnations continue to increase in the industry. Head and tongue condemnations declined substantially in 2016.

The percentage of cattle grading Prime and Choice continues to increase while the percentage of cattle grading Select continues to decrease. While there is not a clear pattern in yield grades since the 2011 audit, it does appear there are fewer cattle qualifying in the leaner categories (yield grade 1 and 2) and more qualifying for the fatter categories (yield grade 4 and 5).

According to results from the most recent audit (2016), the sum of quality grade, yield grade, weight, hide defects

and condemnations average nearly $49 per head, or a total of more than $1 billion annually. Excessive fat and inadequate marbling were identified as the two major value loss items. Together, these two defects account for about 58% of total value losses.

Market Cow and Bull Quality Audits

In 2016, audits were conducted at 18 cow and bull processing facilities across 10 states. In this audit, holding-pen (live animal) audits were conducted at the packing facilities as well as harvest-floor assessments (hide-on and hide-off assessments) and cooler audits. Table 45.2 shows the frequencies of defects identified in the holding-pen audits.

Of particular interest is the high incidence of hide damage from brands, scratching and scarring (Table 45.3). Nearly 64% of beef cows had no brand, while 5.6% had multiple brands, which causes greater devaluation to the hide. The dollar value lost due to hide brands and latent damage in 2016 was estimated to be $7.47. Producers can place brands on the shoulder or hip, rather than the rib to minimize value loss of the hide

There has been an upward trend in body condition scores for beef and dairy cows since 2007, while body condition for bulls has remained nearly the same. Data show there is a greater frequency of over-conditioned beef cows (BCS 8 and 9) and a lesser frequency of cows that are too thin (BCS 1 and 2) than reported in 2007. Researchers classified 7.6% of beef cows as having a body condition score of 1 or 2. Muscle score can be used as a measure of condition and fitness. The beef cow population in the audit has continued to show a drastic improvement in muscling. Nearly 35% of cows were classed as inadequately muscled in 2016, compared to 61% in 2007. The degree of muscling in cattle can be attributed to genetics, previous plane of nutrition and/or animal health. As cows decline in body condition, they lose muscling as well as fat.

Nearly one out of every 10 beef cows had horns. Horns may contribute to the extremely high incidence of bruising in cow carcasses as shown in Table 45.4. Forty-three percent of bulls and 64% of cows had no bruises, with the majority of bruises being classed as "minimal" in severity. Minimal severity means less than one pound of surface trim is

Table 45.3. Frequency (%) of defects identified in holding-pen audits of non-fed cattle.

	Percent of cows		
	1999	*2007*	*2016*
Eye lesions	4.3	3	1.0
Lumpy jaw	1	0.4	1.2
Small horns and scurs	10	8.4	5.3
Large horns	13	10.8	4.5
Brands, beef cows only	60.0	31.3	35.7
Hide scratching or scarring	61.0	45.3	
Hide damage from insects	2.4	3.0	
Lameness caused by arthritis or injury	13.0	16	13
Inadequate muscling, beef cows only	44.4	61	35
Body condition score of 1 or 2 (extremely thin, beef cows only)	2.3	10.0	7.6
Body condition score of 3 or 4 (thin, beef cows only)	38.3	41.1	
Body condition score of 8 or 9 (extremely fat, beef cows only)	4.5	4.2	3.6

Source: National Market Cow and Bull Quality Audit.

Table 45.2. Frequency of carcass, hide and offal defects and carcass traits.

National Beef Quality Assurance Key Practices

BQA

- Provide personnel with training/experience to properly handle and care for cattle. (Code of Cattle Care)
- Make timely observations of cattle to ensure basic needs are being met.
- Provide facilities that allow safe, humane and efficient movement and/or restraint of cattle.
- Use appropriate methods to humanely euthanize terminally sick or injured livestock and properly handle carcasses.

Cattle Care

- Abuse of cattle is not acceptable under any circumstances.
- Provide personnel with timely training/experience to properly handle and care for cattle.
- Make timely observations of cattle to ensure basic needs are being met.
- Design, provide and regularly inspect facilities (fences, corrals, loadouts, alleys, etc.) to help ensure safe and easy animal movement and restraint.
- Keep feed- and water-handling equipment clean.

Biosecurity

- Evaluate the biosecurity risks on your operation and follow a plan to help mitigate risk.
- Recognize and mitigate the biosecurity risks associated with the introduction of new cattle and inter-herd/operational traffic.
- Apply basic sanitation practices to equipment, vehicles and clothing to decrease the chance of microbial contamination.
- Prevent contamination of feed and feeding equipment.

Herd Health

- Develop a herd health plan that conforms to good veterinary and husbandry practices appropriate for the region where cattle are raised.
- Provide disease prevention practices to protect herd health including access to veterinary medical care.
- Follow all FDA/USDA/EPA guidelines and label directions for each product.
- Use FDA approved feed additives including those requiring a veterinary feed directive (VFD) in accordance with label requirements. The FDA requires all VFD records to be retained for two years and available upon FDA request for inspection.
- Keep extra-label drug use (ELDU) to a minimum and only when prescribed by a veterinarian working under a Veterinary/Client/Patient Relationship (VCPR).
- Properly administer products labeled for subcutaneous (SQ) administration in the neck region.
- When available, use products approved for SQ, intravenous (IV), and intranasal (IN) or oral administration rather than products

administered intramuscular (IM) as all products can cause tissue damage when administered IM.
- Always ensure products labeled for IV-only are never given by any other route of administration because of the potential for causing violative residue at the injection site.
- When available, use injectable products with low dosage volumes and follow the proper spacing of injections.
- Administer products labeled for IM in the neck region only – no exceptions, regardless of age.
- Do not administer more than 10cc of product per IM injection site.
- Use the appropriate needle size for injections and never reuse a bent needle.
- Do not market compromised, terminally ill and/or non-ambulatory cattle.
- Humanely euthanize non-ambulatory animals using appropriate methods.

Transporting

- Knowingly inflicting physical injury or unnecessary pain on cattle when loading, unloading or transporting is not acceptable.
- Handle/transport all cattle in such a fashion to minimize stress, injury and bruising.
- Use vehicles to transport cattle that provide for the safety of personnel and cattle during loading, transporting and unloading.
- Follow these guidelines when transporting your own livestock:
  - Perform a structural check of trailer/truck and tires prior to loading livestock.
  - Inspect trailer/truck for cleanliness (biosecurity) as well as broken gates that may injure/bruise cattle.
  - Check weather and route to ensure a safe and uneventful trip.
  - Verify withdrawal on any animals to be sold.
  - Verify all animals are fit to ship.
  - Back up square and evenly to loading chute.
  - Load using low-stress handling practices.
  - Pull away from the chute slowly and drive smoothly to allow cattle a chance to gain their balance in transit.
  - Minimize time in transit by limiting stops and using prior preparation to ensure an organized event.
- Follow additional guidelines when contracting for your cattle to be hauled:
  - Establish good communications/logistics with both the trucking company and receiver of the livestock.
  - Request the truck to arrive clean for loading to decrease biosecurity risks.
  - Ask hauler contractor/driver for proof of BQA Transportation Certification.

Recordkeeping

- Employ strict adherence to pre-harvest withdrawal periods on product labels and to extended withdrawals as determined by a veterinarian within the context of a VCPR.
- Identify all animals with appropriate individual and/or group identification methods.
- When cattle are treated/processed individually or as a group, record the following information:
  - Individual animal identification, or for group treatment/processing, record group or lot identification
  - Date treated
  - Product administered and manufacturer's lot/serial number
  - Dosage
  - Route and location of administration
  - Earliest date animal(s) will have cleared the withdrawal period
  - Name of individual administering the treatment
- Whenever possible, transfer all processing and treatment records with the cattle to the next owner or production level.
- Inform prospective buyers of any cattle that have not met pre-harvest withdrawal times.
- When applicable, keep complete records when formulating or feeding medicated feed rations.
- Maintain records of any pesticide used on pasture or crop that could potentially lead to violative residue.
- Keep records for a minimum of two years or longer as required by law/regulations (e.g. three years for Restricted Use Pesticides).

Nutrition

- Ensure cattle have access to adequate water supply and appropriate nutrition.
- Avoid feed and water interruption longer than 24 hours.
- Only use feedstuffs and feed ingredients of satisfactory quality.
- Under certain circumstances (e.g. droughts, frosts and floods) test feedstuffs or other dietary components to determine the presence of substances that can be detrimental to cattle well-being such as nitrates, prussic acid, mycotoxins, etc.
- Use only USDA-, FDA- and EPA-approved products for use in cattle; these products must be used in accordance with the product label.
- Analyze suspect feedstuffs prior to use and seek supplier assurance of feed ingredient quality.
- Do not feed ruminant-derived protein sources per FDA regulations.
- Support feeding of by-product/co-product ingredients with sound science.

Environmental Stewardship

- Manage forage and water resources with appropriate principles to optimize production while protecting or enhancing the environment.
- Use, store and dispose of all pesticides with care and according to label directions.
- Monitor and manage key environmental control points that affect soil and water resources.
- Properly dispose of carcasses.

Worker Safety

- Maintain a safe workplace and use appropriate personal protective equipment when needed.
- Train employees and others working at your operation on safe practices in using equipment, handling cattle, handling animal health products and working around potentially hazardous areas.

Emergency Action Planning

- Develop and maintain an emergency action plan.
- Inform everyone involved in your operation what to do in case of an emergency.

removed due to bruise damage. Certainly, bruising can be caused by many things besides horns, such as poorly designed and maintained cattle working facilities, overzealous and impatient human handlers and overcrowding in working facilities and trucks. There needs to be a continued emphasis on proper handling to reduce bruising and the associated loss in carcass value.

Actual carcass traits are shown in Table 45.5. Average carcass weight in cows was only 686 pounds. Light carcasses in cows can be largely attributed to high incidence of light-muscled cows in thin body condition, resulting in low dressing percent.

Table 45. 4. Incidence of bruises and severity of trim loss in market cows and bulls.

Severity of Bruises	*Percent of cows*		
	1999	*2007*	*2016*
Extreme	2.4	5.4	1.4
Critical	21.6	12.4	4.9
Major	41.7	30.9	45.1
Minimal	77.2	36.7	67.3
No bruise	11.8	36.6	35.9

Source: National Market Cow and Bull Quality Audit.

Table 45.5. Overall means of carcass traits in market cows and bulls.

Carcass Trait	*Cows*	*Bulls*
Carcass weight, lbs	*686*	*878*
Muscling[a]	2.4	3.0
Fat thickness, inches	0.29	0.14
Fat color[b]	3.2	2.4
LM Area, In^2 (loin muscle)	10.0	12.2

a Muscling score is a subjective measurement (1 =1 lightly muscled, 5 = heavily muscled).
b Fat color score is a subjective measurement (1 = white fat, 6 = yellow, oily fat).
Source: National Market Cow and Bull Quality Audit.

Table 45.6. Targets to improve fed-beef carcass characteristics.

Trait	Target (%)
Yield Grade	
1	10
2	45
3	40
4	5
5	0
Quality Grade	
Prime	5
Upper 2/3 Choice	35
Low Choice	35
Select	25
Standard/Ungraded	0
Carcass Weight lbs.	
<600	0
600-800	20
801-900	30
901-1,000	50
>1,000	0

Meeting the Challenges – BQA Guidelines

Management to Improve Carcass Composition and Quality

Fed-Cattle

Improving quality and consistency of fed-beef carcasses begins first with understanding the industry targets for carcass traits and selecting carcass targets appropriate for the specific operation's type of cattle and production

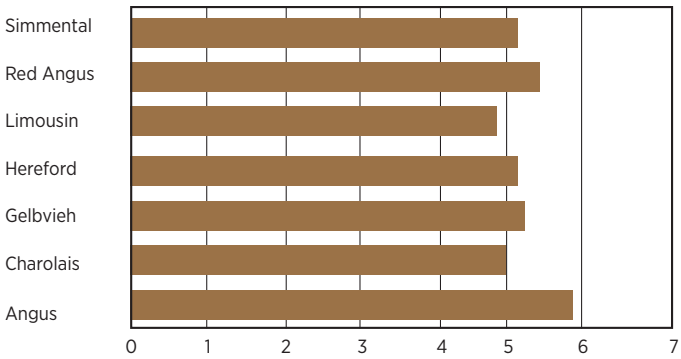

Figure 45.2. Breed of sire influences on marbling score. (Courtesy Kuehn & Thallman)

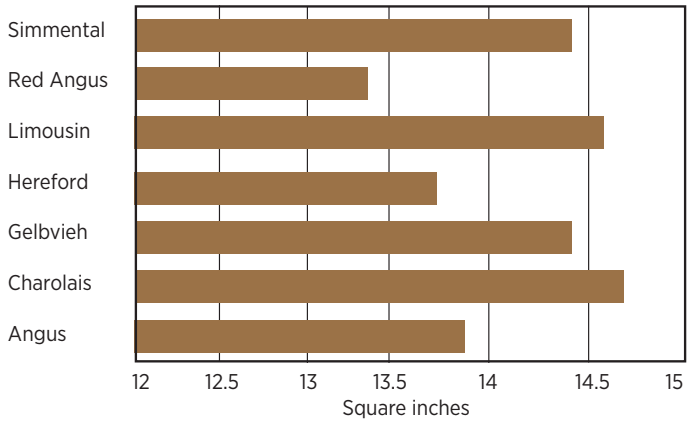

Figure 45.3. Breed of sire influence on rib eye area. (Courtesy Kuehn & Thallman)

environment and/or production system. Targets for carcass defects (injection-site blemishes/lesions, bruises, dark cutters, liver condemnation, etc.) are zero. Industry targets for carcass weight, yield grade, quality grade, ribeye area and other characteristics vary depending on the marketing program for which the cattle are being targeted. For example, the USDA currently has registered more than 70 Certified Beef Programs, all of which have varying carcass targets. Specifications for each of these certified beef programs can be viewed atams.usda.gov/services/auditing/certified-beef-programs.

Based on the National Beef Quality Audit (NBQA) data, carcass composition remains the area where the greatest amount of fed-beef value can be recaptured. Lost opportunities due to quality grades cost the industry $15.75 per head of fed cattle marketed (2016 NBQA). Inappropriate yield grades, as a result of excess fat and/or inadequate muscling, costs the industry $12.91 per head, compared to $5.93 per head in 2011. This decrease in loss of value occurred partly because fewer carcasses are actually assigned a yield grade and more emphasis is given to the marketing of animals to specific programs. To further achieve improvements in these areas, general fed-beef carcass targets are suggested in Table 45.6.

Producers need to establish and follow a methodical plan to make significant progress in improving feed yard performance and carcass composition of their cattle. The

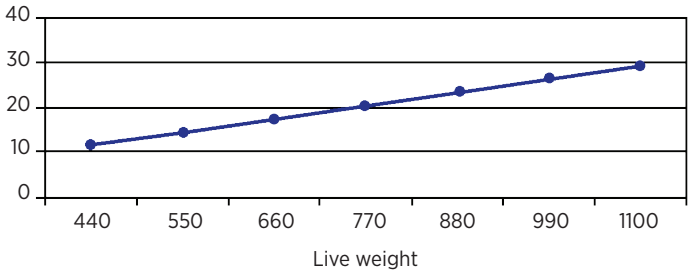

Figure 45.4. Influences of weight (time on feed) on body fat composition.

first step in this plan should be to determine the relative performance and carcass characteristics of cattle at present and to identify a marketing program that best fits cattle management programs. For producers who typically sell calves at weaning or do not care to retain ownership on large numbers of calves, this information can be difficult to obtain. Establishing a relationship with buyers and feeders may be a method to obtain the desired performance data. The use of EPD's and genomic information in breeding programs can certainly help a producer improve cattle performance in areas of interest.

Once carcass targets and current performance have been established, the second step is to use the information gathered to set clear goals for improving feed yard and carcass performance. For example, reducing average yield grade of steer progeny by .25 units within three years, or increasing the percentage of cattle grading average choice by 5% within the same three years may be appropriate goals. The third step is to develop and initiate an action plan to facilitate goal achievement, and the final step is to monitor progress. Chapters 25 through 28 have an extensive discussion of herd improvement through breeding programs by using EPD and genomic information in the selection of replacement females and sires.

Many factors are involved in determining final carcass composition (fat versus lean) and marbling. Some of the major factors known to influence carcass composition are genetics for muscularity (cutability) and marbling, time on feed, age placed on feed, nutritional history prior to being placed on feed, implant regime, season of the year and incidence and severity of sickness. Several of these factors interact with one another to further complicate the issue.

Genetic tools, such as breed selection, within-herd selection (for example culling and replacement heifer retention) sire selection and mating systems are likely the most powerful tools available to producers in influencing feed yard performance and carcass composition. While feed yard performance and carcass composition become more important with time, care must be taken to avoid overemphasizing selection for these traits at the risk of ignoring or even damaging other important genetic traits. Cow herd reproductive performance, milk production and mature size are examples of traits that must be balanced or improved through time, while improvements in carcass composition are achieved.

Breed or breed type has an influence on carcass characteristics. Researchers at the USDA Meat Animal Research Center report across-breed EPD tables on an annual basis. This allows producers to adjust EPDs to a specific baseline and accurately compare sires from two different breeds. Across breed EPD in Table 27.1 is found in this manual. Figures 45.2 and 45.3 show average marbling score and rib eye area (REA), respectively for selected breeds. Calves sired by Angus and Red Angus have higher marbling scores compared to calves sired by Charolais, Gelbvieh, Limousin, Simmental and Hereford. Conversely, calves sired by Continental breeds of cattle (Charolais, Limousin, Gelbvieh and Simmental) produce carcasses with higher REA (higher cutability) compared to calves sired by English breeds of cattle (Angus, Red Angus and Hereford).

It should be recognized sires are available within each breed that excel in producing carcasses with higher-than-breed-average quality grades and lower-than-breed-average yield grades. By selecting a breed or breed combination of cattle, and by applying selection principles and mating systems appropriate for the production system and marketing program, producers can make substantial improvement in feed yard performances and carcass characteristics through time.

Age placed on feed is often thought to play a major role in feed yard performance and carcass characteristics. This variable is frequently closely related to and compounded with days on feed. It is not uncommon for cattle to be placed on feed anywhere from 2 months to 18 months of age in the U.S. However, two very common production systems in Oklahoma are to place calves on feed at weaning—about 5 months to 9 months of age (calf-fed) or to place them on feed as yearlings, when they are anywhere from 11 months to 16

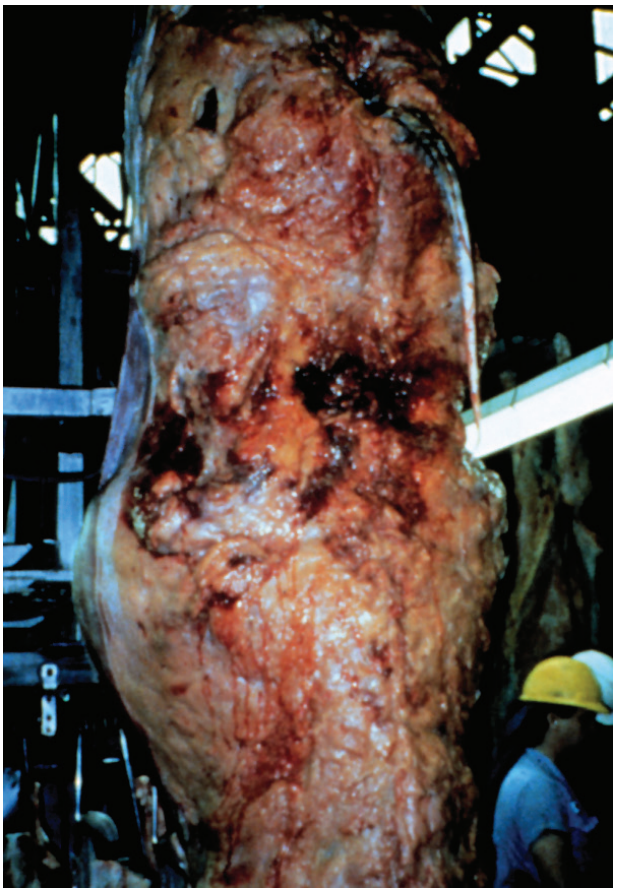

Figure 45.5. Bruises cost the cattle industry $22 million annually.

months old. Obviously, time on feed varies dramatically, depending on the rate of gain during the stocker phase, frame size of cattle, fleshiness of the cattle at different times and market conditions. Several experiments have been conducted to document differences in carcass characteristics and feed yard performance among calf-fed versus yearling-fed production systems. In general, when cattle from both production systems are fed to a constant back fat endpoint, yearling-fed cattle, compared to calf-fed cattle, have heavier placement weights, increased intake, faster rates of gain, poorer feed conversion, less days on feed and larger live carcass weights.

Surprisingly, the research indicates that average quality grade and yield grade are not substantially different, assuming the cattle are harvested at a constant back fat thickness. Therefore, according to this research, the choice of production system primarily influences live carcass weight. Thus, carcass weight parameters defined in the targeted marketing program and the type of cattle (large versus medium frame) should be considered in this decision. Many other factors will be involved in this decision as well, such as market conditions and available ranch resources.

Days on feed is highly and positively correlated with live body weight, body fat (Figure 45.4), carcass weight, yield grade and, to a lesser extent, percent grading choice or higher. Therefore, producers can use days on feed as a powerful tool to manipulate back fat thickness and yield grade. Previous history of the ranch's cattle is necessary to use as a benchmark and to determine if days on feed should be increased or decreased.

It is well documented that sickness reduces feed yard performance, carcass weight and percentage of cattle grading choice and higher (Lalman and Smith, 2000). Therefore, any management steps taken to minimize the risk of sickness and the severity of sickness will ensure optimum feed yard and carcass performance.

Cows and Bulls

Improving characteristics of non-fed beef carcasses is primarily an issue of market timing and culling management. Research concluded that cows in a BCS 6 at harvest optimized returns to producers and processors, based on quality grade and lean meat yield (Apple, 1999). Therefore, cattle with physical disorders, such as arthritis and stifle joint infections should be marketed before they become excessively thin (less than BCS 4).

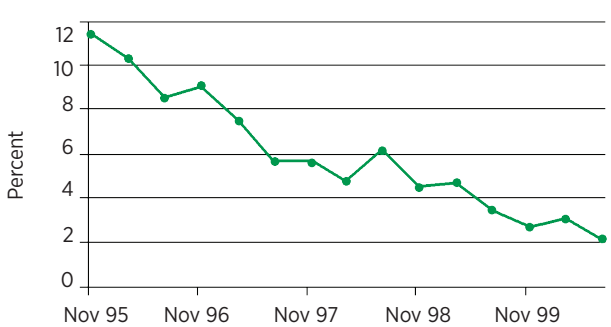

Figure 45.6. Incidence of injection-site lesions in fed-beef sirloin top butts.

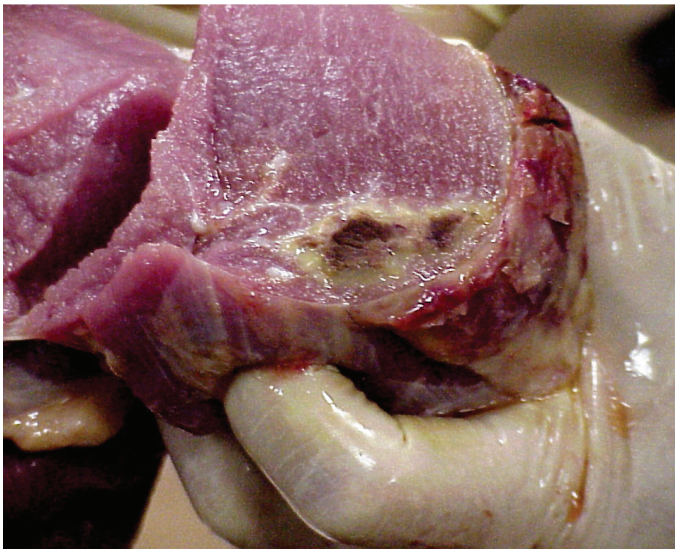

Figure 45.7. Fluid-filled injection-site lesion. Source: Boyles.

Each year, producers should examine the teeth or mouth of cows 8 years of age and older. Any cow developing a broken mouth or having lost several teeth should be either marketed before she loses substantial weight and condition or put on a culling list to be identified and culled at the earliest opportunity.

Managing cows to gain weight before marketing may be a profitable alternative, if the animals are healthy and high-quality forages or moderate- to low-cost concentrate feeds are available. When healthy thin cows are not lactating and are grazing high-quality forage such as spring and early summer grass or wheat pasture, they can gain one full body condition score in about 30 days. High-concentrate feeding programs also can be used to rapidly improve body condition of thin healthy cows. However, producers should recognize that feed conversion in mature cows is not very efficient compared to growing cattle. In fact, most studies suggest feed conversion in thin cows receiving a high concentrate ration (85% to 95% concentrate) is in the neighborhood of 9 pounds to 10 pounds of feed per pound of weight gain. This compares to a conversion of between 5.5 pounds to 7 pounds of feed per pound of weight gain in calves and yearlings. Cows that do not raise a calf should be marketed before they become excessively fat.

Disabled or downer cattle are no longer allowed in the food chain and should be humanely euthanized on the farm with the direction of a veterinarian.

Minimizing Dark Cutters

Dark cutters result from preharvest stress, which depletes muscle glycogen stores. Without sufficient glycogen in the carcass, lactic acid cannot be produced to reduce the pH of the meat. The result is dark, firm and dry lean. Inclement weather, growth promotants, genetics, disposition and handling practices before harvest all play a role in causing dark cutters. Using low-stress animal handling techniques and good management practices greatly reduces incidences of dark cutters.

Table 45.7. Guidelines for needle selection for cattle.

	Route of administration								
	SQ (1/2- to 3/4-inch needle) Cattle Weight			IV (1 1/2-inch needle) Cattle Weight			IM (1- to 1 1/2-inch needle) Cattle Weight		
Injectable viscosity	<300	300 to 700	>700	<300	300 to 700	>700	<300	300 to 700	>700
Thin example: virus vaccine	18 gauge	18 to 16 gauge	16 gauge	18 to 16 gauge	18 to 16 gauge	16 to 14 gauge	20 to 18 gauge	18 to 16 gauge	18 to 16 gauge
Thick example: oxytetracycline	18 to 14 gauge	18 to 14 gauge	14 gauge	18 to 16 gauge	18 to 16 gauge	16 gauge	18 to 16 gauge	18 to 16 gauge	16 gauge

Select the needle to fit the cattle size (the smallest practical size without bending).

Minimizing Carcass Bruising

Approximately 39% of fed beef and 64% of market cow and 43% of bull carcasses exhibited bruising (Figure 45.5). While the frequency of bruising has increased as reported in the 2016 audit, the severity of bruising has decreased, with a high percentage of bruises classed as minimal. Producers can have a tremendous impact on reducing the incidence of this value-degrading defect. Bruising from improper cattle handling and management is costly to the cattle industry. An understanding of cattle behavior will facilitate handling, reduce stress, reduce bruise defects and improve both handler safety and animal welfare.

Any protruding objects such as broken boards, nails or exposed bolts should be removed/repaired from working facilities. This also includes horns, which should be removed by breeding selections or manually. Tipping of horns does not reduce bruising as most of the horn is still present. Protruding objects at times may be easily identified. They will typically be shiny or rubbed and often have tufts of hair. Corners and sharp objects that cannot be removed may need to be padded. Rubber tires or pieces of hose work well to soften the impact on cattle.

Gates and flooring also can cause bruising. Make sure not to throw a gate into the side of an animal, as it may become wedged between the gate and the fence. Concrete flooring also will require scoring with an 8-inch diamond pattern with one-inch deep groves, so cattle can gain traction when handled.

Figure 45.8. Correct injection site. Source: Boyles.

Processing, Treatment and Use of Animal Health Products

A series of audits designed specifically to monitor the incidence of injection-site lesions in top sirloin butts of fed beef began in November 1995 and continued in March, July and Noember of each following year. As an example of how improvement can be made with improved awareness—resulting in an industry-wide management change—injection-site blemishes declined from a high of 11.4% in 1995 to a low of 2.06% in July 2000 (Figure 45.6). Much of this dramatic improvement can be attributed to beef producers in each segment moving injection sites from the hip to the neck region.

However, the results of the first market cow and bull quality audit in 1994 showed the percentage of injection-site lesions in nonfed cattle was found to be 28.9%. In the 1999 audit, which included cull dairy cows, this number increased to 40.9%; however, in the 2007 audit, this number decreased to 33%. Contrary to popular belief, not all beef from market cows is marketed as ground beef. For example, ribeye rolls and rounds from market cows and bulls are used in products such as Philly steak and roast beef sandwiches.

Moving the injection-site area to the neck stops damage to expensive steak cuts and allows easier identification of these lesions in the processing plant. There is a negative relationship between meat tenderness and injection sites, including injection sites with no visible lesion. All intramuscular (IM) injections, including sterile water, create permanent damage at the time the product was administered, regardless of the age of the animal. At the very least, tenderness is reduced in a 3-inch area surrounding the injection site (Figure 45.7).

Correct administration of any injection is a critical control point in beef production and animal health. Producers can help to avoid product discounts as a result of abscesses and lesions, and maximize the effectiveness of the animal health product being used by following these simple procedures:

1. Use well-designed cattle-restraining facilities to make the job of giving injections in the proper location safer and easier. Improper animal restraint is the cause of most bent needle problems. By providing proper restraint, the appearance of broken needles in beef products can be avoided. In the event a needle is broken off in the neck muscle, a veterinarian should be immediately contacted and the broken needle surgically removed. A broken needle is an emergency and time will be of the essence. Broken needles migrate in tissue and will be impossible to find if not immediately handled, requiring the animal to be destroyed. Under no circumstances should animals with broken needles be sold or sent to a packer.
2. Use the needle size proper for the situation (Table 45.7).
3. Purchase high-quality needles, change needles often—every 10 head to 15 head — and discard damaged needles or needles contaminated by feces or irritating chemicals. Use only a sterile needle to pull vaccine or medicine from a bottle. This keeps the contents in the bottle sterile.
4. Properly dispose of used or damaged needles. Place the needles in a hard plastic or rigid cardboard container with a secure lid. Label the container Sharp Objects for Disposal.
5. Give injections according to label instructions. Route descriptions follow: subcutaneous (SQ) means under the skin, intramuscular (IM) means in the muscle, intravenous (IV) means into the vein, orally (PO and/or O) means in the mouth or in water and (MF) indicates medicated feeds.
6. Check product labels closely and administer the product as specified on the label. Select products that have subcutaneous (SQ) as an approved route of administration. Remember to tent the skin for SQ injections unless advised otherwise by the manufacturer.
7. All injections must be administered in front of the point of the shoulder, approximately 1.5 inches or more only, no exceptions. (Figure 45.8).
8. Administer less than 10 cc per IM injection site unless a larger volume is recommended on an approved label.
9. During bad weather, take extra care so the injection site is free of manure and dirt, and syringes and needles are clean and disinfected. Injecting cattle during wet weather increases the potential for carrying a contaminant into the injection site.
10. Overall sanitation of equipment and the working area, as well as the cleanliness of employees and coworkers will reduce injection-site defects. A sound educational effort directed at people handling the cattle offers great potential for helping eliminate or minimize these problems.

Responsible Drug/Vaccine Use

The United States Food and Drug Administration (FDA) is responsible for determining the market status of animal drugs, based in part upon whether or not it is possible to prepare adequate directions for use with which a layperson can use the drugs safely and effectively. The two basic classes of drugs available to livestock producers are over-the-counter (OTC) and prescription (Rx) drugs. A drug with significant potential for toxicity in humans or animals (or other harmful effects), may have a unique method of use or requires other special considerations for its use and usually labeled as a prescription drug. Such products can be used or dispensed only by or on the order of a licensed veterinarian and the label must bear the legend: Caution: Federal law restricts this drug for use by or on the order of a licensed veterinarian. Always read the label and follow the directions of your veterinarian.

Withdrawal Times

A withdrawal time may be indicated on the label of certain medications. This is the period of time that must pass between the last treatment and when the animal will be slaughtered or milk used for human consumption. For example, if a medication with a 14-day withdrawal period was last given on August 1, the withdrawal would be completed on August 15 and would be the earliest the animal could be harvested for human consumption. All federally approved drugs will include the required withdrawal time

Veterinarian _____ **Phone** _____

Address _____ **Date** _____ **Expires** _____

Owner/Farm _____ **Animal ID** _____ **Species** _____

Active Ingredients/Concentration _____

Quantity _____ **Drug Trade Name** _____

Indications _____

Directions - Give _____ **cc/bolus/oz** _____ **times each day for** _____ **days**

Drug withdrawal time for slaughter _____ **days**

Test for Residues - Urine _____ **Blood** _____

Figure 45.9. Example of a label a veterinarian may use for extra-label drug use.

for that drug on the product label or package insert. These withdrawal times can range from zero days to 60 days or more. It is the producer's responsibility to be aware of withdrawal times of any drugs used in their operation.

Unacceptable levels of drug residues detected in edible tissues collected at harvest may result in trace-back, quarantine and potential fines or jail time. Substantial economic losses may result for the individual producer as well as negative publicity for the entire beef industry. Producers are responsible for residue problems and should follow these three rules:

1. Do not market animals for food until the withdrawal time listed on the label or as prescribed by the veterinarian has elapsed.
2. Use only medications approved for cattle and exactly as the label directs or as prescribed by a veterinarian.
3. If ever in doubt, rely on the veterinarian-client-patient relationship established with a veterinarian. Consult your veterinarian with all questions and concerns.

Extra-Label Drug Use

Over-the-counter (OTC) drugs can be purchased from multiple sources and must be used as directed on the label. For example, most procaine penicillin G products are labeled for use at 1 cc per cwt. and are given intramuscularly (IM). Therefore, a 600-pound calf would get 6 cc IM. Producers are not allowed to change the dose or give it by any other route, such as subcutaneously (SQ). OTC products must be used exactly as labeled.

Extra-label use is defined as the actual or intended use of a drug in a manner not in accordance with the label. Under the provisions of the Animal Medicinal Drug Use Clarification Act of 1994, the FDA recognized the professional judgment of veterinarians, and allows the extra-label use of drugs (either OTC or Rx) by veterinarians under certain conditions. Extra-label use is limited to situations when the health of an animal is threatened or suffering, with death as a possible result from failure to treat, and only by or under the supervision of a veterinarian. Veterinarians only may consider using drugs (OTC or Rx) in an extra-label manner when there is no approved drug labeled for such use. The veterinarian will establish an extended withdrawal period and record patient ID as well as document when withdrawal periods are met. The product also will have additional labeling for producer reference (Figure 45.9).

It is important to establish a veterinarian-client-patient-relationship (VCPR) and extra-label drug use may only be used within the scope of the VCPR. For a VCPR to exist, the veterinarian has assumed the responsibility for making clinical judgments regarding the health of the animal(s) and the need for medical treatment and the client has agreed to follow the veterinarian's instructions. Also, the veterinarian must have sufficient knowledge of the animal(s) to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s). This means the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of an examination of the animal(s) or by medically appropriate and timely visits to the premises where the animal(s) are kept.

The privilege of extra-label use of drugs is not permitted in animal feeds. A veterinarian cannot use or prescribe drugs for use in feed in any manner except for the approved use and at the approved dosage. Extra-label use of drugs in treating food-producing animals for improving rate of weight gain, feed efficiency or other production purposes is prohibited. Some specific drugs are completely prohibited for extra-label use in food-producing animals including chloramphenicol, clenbuterol, diethylstilbestrol, dimetridazole, ipronidazole, other nitroimidazoles, furazolidone, nitrofurazone, fluoroquinolones and glycopeptides.

Drug Storage

Drugs, vaccines, implants and other animal health products usually have specific storage requirements. Some, but not all, require refrigeration and all should be stored in a clean place where they cannot become dirty or contaminated. Observe and obey the manufacturer's recommended storage instructions for each product used. Where refrigeration is needed, be sure the refrigerator is kept clean and is located in a safe, clean place that is not likely to be overheated or contaminated by dirt or manure. The temperature should be monitored with a thermometer. Animal health products should be stored away from the feed ingredient or mixing areas unless they are regularly mixed feed additives. Storage of bottles of partially used medication or vaccine is discouraged because they may have become contaminated and could cause infections or tissue reactions if reused. Purchase of animal health supplies in containers holding the number of doses typically used in a day of processing animals is encouraged.

Syringe Care

Inadequate vaccine syringe cleaning is frequently responsible for localized infections associated with vaccination. If the infection is severe, it may become generalized and the animal may die.

Injection-site swelling is common, especially when vaccines such as clostridial bacterins are given SQ. If the swelling is hard, it could be due to getting the subcutaneous injection too deep and penetrating part of the first layer of muscles. If this is the cause, consider using a "B-Bevel" 5/8-inch needle or a short (1/2-inch or 3/4- inch) regular bevel needle. The injection point on the B-Bevel needle is shorter than a regular injection needle.

Sterile disposable syringes will virtually eliminate injection-site infections. If you require multiple-dose syringes, several brands of disposable sterile automatic vaccine syringes are available.

Syringe Cleaning Steps

1. Clean only the external syringe surface with soap, water and a brush.
2. Rinse the inside components of the vaccine syringe, including tubes and connectors with distilled or deionized water near the boiling point (greater than 180 F).
   - This is accomplished by drawing water hotter than 180 F into the syringe and squirting it out. Three to

five rinses should be adequate.
- Remove as much water from the inside of the syringe as can be squirted out and let the syringe cool before using. Heat kills modified live vaccine (MLV) products.
- DO NOT use soap or disinfectant on internal components as residues may kill MLV vaccines and may alter killed vaccine efficacy.

3. Store the vaccine syringe in a dust free, dry (low humidity) environment.
   - It is best if the newly cleaned vaccine syringe is stored in a new plastic zip bag and placed in the freezer.

Vaccine Handling Precautions

Attention to details while storing, handling and administering vaccines can determine the outcome of the herd health program. The following practices will enhance the effectiveness of the program.

- READ THE LABEL.
- Purchase new vaccines and store them in a refrigerator.
- Purchase vaccines in containers holding the number of doses appropriate for the task at hand. Storing partially used containers may lead to infections at injection sites, resulting in ineffectiveness of the vaccine.
- Never use an outdated drug or vaccine.
- Use transfer needles to reconstitute vaccines. In general, place one end of the needle into the sterile liquid, and the other in the bottle containing the freeze-dried cake of vaccine. A vacuum should immediately pull the liquid down. If not, discard the vaccine, as it may not be effective. Some products require special transferring techniques. Special instructions will be included on the label.
- Modified live vaccine begins to degrade, or lose effectiveness, after about 90 minutes. Do not mix too much vaccine at one time. Direct sunlight also degrades the products, so keep vaccines and syringes in a cooler while working cattle. When using a large bottle of vaccine, mix thoroughly at first and gently shake the bottle often.
- Do not use the same syringes to inject modified live and killed products. A trace of killed product can harm the effectiveness of the modified live product.
- Clean the top of the vaccine bottle before inserting needles. To avoid contaminating the vaccine, do not put the needle used to inject animals back into the vaccine bottle. Change needles every 10 uses to 15 uses. Discard any bent needles.
- Never mix vaccines or other animal health products. Mixing unlike products can destroy their effectiveness. Use only approved combinations.
- A dangerous practice is to store veterinary drugs in the feed room. This is especially true for pesticides, which could be accidentally mixed into a feed ration.

Care and Husbandry Practices

Sound animal husbandry practices – based on research and decades of practical experience – are known to impact the well-being of cattle, individual animal health, herd productivity and carcass quality. Because cattle are produced using a variety of management systems, in very diverse environmental and geographical locations in the U.S., there is not one specific set of production practices that can be recommended for all cattle producers to implement. Personal experience, training and professional judgment are key factors in providing proper animal care. Following are suggestions when putting a Beef Quality Assurance system into place within a beef production enterprise.

Figure 45.10. Providing a balanced diet is a critical component of BQA.

Biosecurity

Biosecurity is a practice designed to prevent the spread of disease by minimizing the movement of biologic organisms (viruses, bacteria, rodents, etc.) onto and within your operation. Preventing, or at least minimizing, cross contamination must be a primary focus of all activities on a livestock operation.

Biosecurity can be very difficult to maintain because of the very complex interrelationships between management, biologic organisms and biosecurity. Biocontainment may be the only practical control for many diseases. While developing and maintaining biosecurity is difficult, it is the least expensive and most effective means of disease control available. Disease prevention programs will not work without detailed attention to biosecurity.

Livestock Facilities

Facilities (fences, chutes, shelters, etc.) should be maintained in good working condition and cleaned periodically to provide efficient movement and reduce stress when working cattle. Corrals, pens and chutes should be the proper size for the number of animals and the type of processing being done. This allows for proper ventilation and reduces stress on animals while in confinement. Good drainage of water is essential to reducing stress and increasing the health of animals in confinement. Sharp objects and protrusions can result in bruising and should be avoided whenever possible. Equipment to restrain cattle should allow for quick and secure restraint to minimize

Figure 45.11. Cow with BCS of 4.

Figure 45.12. Cow with BCS of 7.

Figure 45.13. Quality control of the feed supply is a critical control point of BQA.

stress or injury to the animal or the operator. Experienced and trained personnel should operate restraining equipment.

Beef cattle are produced in a variety of production settings, from pasture and range to dry lot and confinement facilities. When behavioral and physiological characteristics of cattle are matched to local conditions, beef cattle thrive in virtually any environment without artificial shelter. However, during extreme weather conditions, cattle should have access to well-drained resting areas and/or to natural or constructed shelter.

Transportation

Maintaining a safe working environment for both cattle and people is an essential part of cattle transportation. Simply inspecting loading facilities and trailers for safe operation prior to loading helps prevent any unwanted accidents from occurring.

Proper maintenance and inspection of the loading facilities, vehicle and the trailer can prevent injury. A good time to inspect the trailer is once it has arrived and is in place, but before loading the animals. Trailer tires and floors often are the most worn parts of the trailer. Tires should be in good condition, properly inflated and free of dry rot. Floors should be clean and well-maintained. Cattle can easily lose traction on dirty or wet flooring, which can cause injury. Wood floors are common in many stock trailers and should be inspected, as they can deteriorate through time, especially if the trailer is not cleaned after use. Some stock trailers use rubber flooring or mats. These increase traction for animals and often stand up to urine and manure better than wood floors. If mats are used, ensure the floor is dry after cleaning because the mat can trap moisture underneath.

Sorting and loading practices also can help prevent injury to both workers and animals. Sorting cattle by size prior to loading prevents injury to smaller animals. This allows the trailer to be loaded according to its designed specifications and load limits. Before loading, the trailer needs to be properly positioned without open space on the sides or a gap between the trailer and the working facility. This will prevent cattle from getting a leg or neck caught while approaching the trailer. When loading cattle, leave enough room for animals to stand. Overcrowding can cause cattle to be trampled and injured inside the trailer. For smaller loads, partition cattle into appropriately sized areas by closing off interior gates rather than leaving the entire area open. This will increase stability for both cattle and the trailer. Producers also should plan for weather-related stress conditions while transporting cattle and plan accordingly. There is now a BQA Transportation certification program that can be accessed along with additional information regarding cattle transportation at BQA.org.

Nutrition and Feedstuffs

Nutrition

Cattle should have access to an adequate quantity and quality of nutrients for body maintenance and growth (Figure 45.10). For grazing cattle, the primary nutrient source is forage. There are times, however, when supplementation or complete feeding is required, such as during winter when adequate forage is not available or when forage quality is low. In these cases, producers are challenged with designing a feeding or supplementation program designed to match

the forage supply. This can be difficult because nutrient requirements of cattle vary according to age, sex, weight, body condition, stage of production and environmental temperature. Specific guidance for formulating effective supplementation programs and rations for cattle are provided through local OSU Extension offices and at the Beef Extension website at beefextension.okstate.edu. Tabular values of nutrient requirements for various classes of cattle are available, and tables showing typical nutrient values of common feeds are provided. Additionally, easy-to-use computer software is available for producers to download and use.

Cattle should have access to an adequate supply of clean water at all times. Water requirements vary greatly, and consumption will normally range from 1 gallon per 100 pounds of body weight during cold weather, to nearly 2 gallons per 100 pounds of body weight during hot weather.

An excellent tool to evaluate the effectiveness of an animal's current nutritional status is the body condition scoring (BCS) system (Figures 45.11 and 45.12). Scores range from 1 (very emaciated) to 9 (obese or excessively fat). The optimum range for cows at calving time is BCS 5. Cows calving below BCS 5 produce less colostrum, lower-quality colostrum and have decreased milk production. Nutritional stress can impact the animal's health and immune system, thereby emphasizing the need for the proper balance of protein and energy to the nutritional needs of cattle.

Feedstuffs

Since most beef cattle operations purchase feeds from outside sources, quality control of the supply is a critical control point in beef quality assurance (Figure 45.13). Maintaining feed records and closely adhering to feed additive label directions and withdrawal times also should be considered critical control points. Feeding byproduct ingredients should be supported with sound science. Ruminant-derived animal protein feeds are not allowed to be used under current federal law. High-risk byproduct ingredients include fats, rendered byproducts and other plant-based byproducts, such as glycerol from corn-based ethanol production. These may be single loads or batches that will be fed to cattle for a prolonged period of time. If purchasing fats and oils, monitor for potential contaminants. Letters of guarantee from companies supplying these materials may be requested that state these materials have been tested.

Veterinary Feed Directive

Under the Animal Drug Availability Act (ADAA) of 1996, congress created a new category for drugs called veterinary feed directive (VFD) drugs. Prior to this new rule, all drugs were classified by the Food and Drug Administration (FDA) as over-the-counter (OTC) or prescription (Rx) drugs. A VFD drug is an animal drug intended for use in or on animal feed that requires the supervision of a licensed veterinarian.

VFD drugs are not prescription drugs. Prescription drugs are not mixed in or on animal feed. Prescription drugs may be used under certain conditions in an extra-label manner, which is not permitted for VFD drugs. VFD drugs are not governed by state pharmacy laws unlike prescription drugs, which are governed.

Until now, only a select few drugs have been designated VFD drugs. On June 3, 2015, the Food and Drug Administration (FDA) released the final version of the amended new animal drug regulation for the VFD drugs (21CFR558.6). The revised rule changed all OTC feed grade antimicrobials considered medically important antimicrobial drugs (drugs that are important for therapeutic use in humans) to VFD drugs. Some of the common OTC beef cattle drugs used in or on feed affected by the change in the rule are chlorotetracyline, neomycin, oxytetracycline and sulfas. A few drugs not considered important in human medicine such as ionophores, coccidiostats, bacitracins, bambermycin, carbadox and pleuromutilin continues to be available OTC.

In keeping with the FDA's theme of judicious use of medically important antimicrobials, pharmaceutical companies have voluntarily agreed to remove any growth-performance claims from the label of VFD drugs. This means using any of these drugs for weight gain or improved feed efficiency is prohibited. Emphasis is placed on using these drugs for prevention, control and treatment of diseases with the oversight of a veterinarian.

VFD feeds may only be purchased with a VFD order. A VFD order is a written statement that a licensed veterinarian issues after examining and diagnosing an animal(s) condition. When the veterinarian deems it necessary to treat, control or prevent the disease, they may order the use of a VFD drug or combination VFD drug in or on animal feed. A producer may obtain a VFD order from their veterinarian, provided they have a proper Veterinary-Client-Patient-Relationship (VCPR). The definition of a VCPR is defined by the federal regulation as:

1. A veterinarian has assumed the responsibility for making the medical judgements regarding the health of (an) animal(s) and the need for medical treatment; and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian.
2. There is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s).
3. The practicing veterinarian is available for followup in case of adverse reactions or failure of the regimen of therapy. Such a relationship can only exist when the veterinarian has recently seen or is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s) and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

A valid VFD should contain the following information:

- Veterinarian's name, address and phone number.
- Client's name, address and phone number.
- Premises at which the animals specified in the VFD are located.
- Date of VFD issuance.
- Expiration date.
- Name of VFD drug.

Figure 45.14. Check the product label for grazing restrictions following application of pesticides on grazing lands.

- Species and production class of animals to be fed.
- Approximate number of animals.
- The indication for which the VFD is issued.
- The level of VFD drug in the feed and the "Duration of Use."
- The withdrawal time, special instructions and cautionary statement.
- "Reorders or Refills."
- The statement: "Use of feed containing this veterinary feed directive (VFD) in a manner other than directed on the labeling (extra label use) is not permitted."
- An affirmation of intent for combination VFD drugs.
- Veterinarian's signature.

Premises is a description of where the animals are located. It needs to be specific enough for someone not familiar with the area to find those animals. A producer may include landmarks, GPS information or pen numbers in addition to an address to help better describe the location.

The "expiration date" specifies the last day a VFD feed can be fed, not the date the drug becomes ineffective. In the drug approval process, some drugs have this information included on the label, but not all. For those drugs without a specified date, the veterinarian will assign an "expiration date" not to exceed six months. Producers may not feed the VFD feed beyond the "expiration date." If a producer cannot complete the therapy before the "expiration date," the producer should contact their veterinarian and obtain a new VFD.

The "duration of use" determines the length of time that the animal feed containing a VFD drug is allowed to be fed to the animals.

Some producers may question the difference between "expiration date" and "duration of use." The "expiration date" is the last day the feed may be fed. The "duration of use" is number of days of therapy. For instance, if a VFD drug has an "expiration date" of 45 days and a "duration of use" of 14 days, the producer has 45 days to obtain the VFD feed and complete the 14 days of therapy. If the VFD drug label does not specify the "expiration date" or "duration of use," then the veterinarian will specify those dates, which may not exceed six months.

During the drug approval process if a reorder (refill) is approved, then a veterinarian is permitted to authorize a reorder. If the label is silent on reorders, a veterinarian may not authorize a reorder.

"Extra-label" use of VFD drugs or OTC drugs in feed is strictly forbidden by the producer or the veterinarian. A producer may not feed the VFD feed in a manner different than the label specifies. Examples of "extra-label" use are feeding to a different species, feeding at a different concentration, feeding longer than the "duration of therapy" or feeding past "expiration date."

A VFD drug may be combined with another VFD drug or OTC drug if specified by the label of the VFD drug. A veterinarian must specifically allow for a VFD drug to be combined with another VFD drug or OTC drug in the VFD order.

A producer has certain responsibilities when feeding a feed containing a VFD drug. A producer is responsible for feeding a feed with a VFD drug according to the label written by the veterinarian. They must not feed the VFD feed beyond the expiration date. Lastly, a producer must maintain a copy of the VFD order for a minimum of two years and provide a copy of the VFD order for inspection and copying, if requested by the FDA.

If a producer wishes to obtain more information about veterinary feed directives, they may view the document Code of Federal Regulations, Title 21, chapter I, Subchapter E, Part 558 or go to fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm071807.htm .

Figure 45.15. Mycotoxin contaminated corn prior to harvest.

Contamination from Pesticides

Pesticides are an important tool in livestock production to control insects and weeds. However, inappropriate use of these products can lead to chemical residues in beef, unsafe human exposure to chemicals and groundwater contamination. Consequently, only agricultural chemicals approved for application to land grazed by livestock or on land where feedstuffs are removed for animal consumption

at a later time should be used (Figure 45.14). Be sure to follow label directions and observe grazing restrictions on pastures, rangeland and crops treated with pesticides. Store all chemicals (pesticides, lubricants and solvents) away from feed supplies. The final step in ensuring the safe use of pesticides is to document usage and observe appropriate withdrawal times before marketing cattle. Pesticide use records should be maintained for a minimum of three years.

Oklahoma Pesticide Law requires the registration of all pesticides distributed, sold or offered for sale within the state. Each pesticide product must be registered annually with the Consumer Protection Services Division of the Oklahoma Department of Agriculture, Food and Forestry. This law also provides for the sampling and chemical analysis of pesticides distributed, sold or offered for sale in the state. Under the Pesticide Law, it is unlawful to distribute, sell or use any registered pesticide in a manner inconsistent with its labeling.

The Environmental Protection Agency is directed by federal law to classify all pesticides for either general use or restricted use. Pesticides classified for general use may be purchased by the general public and applied according to the label directions. Pesticides classified for restricted use may be purchased and applied only by certified applicators or individuals working with the direct supervision of a certified applicator.

A certified applicator is any individual who is certified to use or supervise the use of any pesticide that is classified for restricted use. Applicator certification is available in several classes, including: Private Applicator, Commercial Applicator, Noncommercial Applicator and Service Technicians. Information on the appropriate certification class and certification procedures can be obtained through your OSU Extension office or through the Oklahoma Department of Agriculture, Food and Forestry's Consumer Protection Services Division (405-521-3864 or oda.state.ok.us/cps/index.htm).

Mycotoxins

Mycotoxins are naturally occurring chemicals produced by fungi. They can be found in grains and forages, and if present in sufficient concentrations, can cause reduced feed consumption, weight loss, abortions and residues in meat and milk products. Mycotoxins can be produced in feedstuffs prior to harvesting or during storage. Mycotoxins may include vomitoxin, aflatoxin, fumonisin and zearalenone. Guidelines established by the Food and Drug Administration and the Oklahoma Animal Disease Diagnostic Laboratory for allowable concentration of aflatoxin (one of the most common mycotoxins in Oklahoma) contamination in feedstuffs for cattle are:

Lactating dairy cattle	20 ppb[1]
Immature livestock	20 ppb
Breeding cattle	100 ppb
Finishing cattle	300 ppb

[1] Parts per billion.

Mycotoxin production in the field is very difficult to control (Figure 45.15). Drought conditions and hail frequently predispose grain to infection by toxic fungi. Consequently, incoming feed ingredients, including freshly harvested feed grains and forage, should be monitored for possible mycotoxin contamination. Storing feed and grain at low moisture content and temperatures will help prevent fungus growth. Apply chemical preservatives according to label directions to ensure complete coverage of the feed or grain. Monitor and aerate treated feed or grain the same as dry grain.

Cleanliness in feed storage facilities, transportation equipment and feeding areas reduces possible mycotoxin contamination of feeds. Remove caked and molded grain from transport trucks, storage bins, conveyors and feeding troughs. If the presence of mycotoxins is questionable, a feed sample should be submitted to a qualified laboratory for quantitative analysis.

No Ruminant-Derived Protein

No ruminant-derived protein sources can be fed. As of 1998, federal regulations prohibit the feeding of certain mammalian protein sources. The regulations primarily impact the feeding of meat meal and bone meal derived from ruminants. This restriction is a key critical control point to prevent the establishment or amplification of bovine spongiform encephalopathy in the U.S. through the consumption of specified risk material. Tallow, blood byproducts, gelatin products and milk products are excluded by the regulation and are acceptable for use in ration formulations.

Feed Additives and Medications

The use of medicated feeds for livestock is regulated by the FDA. Feed mills that mix certain premixes are required to register with the FDA and are subject to routine inspections. Other feed-mixing facilities, including on-farm mixing facilities are not required to register with the FDA but are required to follow Current Good Management Practices (CGMPs). CGMPs include the following:

1. Facilities and equipment should be constructed and maintained to minimize vermin and pest infestation; allow proper maintenance and cleaning; accurately produce feed of intended use; and prevent accidental contamination from fertilizer, pesticides or other contaminants.
2. Quality assurance of feed products through identification, storage, inventory control, documented corrective actions and adherence to label instructions.
3. Proper equipment cleanout procedures to prevent carryover.
4. Proper labeling and complete records of feed formulations.

A more complete document outlining CGMPs for non-registered feed mills is available from the FDA at fda.gov/.

Only FDA-approved medicated feed additives should be used in rations. Extra-label use of feed additives is illegal and

strictly prohibited. To avoid violative residues, withdrawal times must be strictly followed. Complete records must be kept when formulating or feeding medicated feed rations. Records are to be kept a minimum of three years.

Records

Importance of Records

Recordkeeping, either on a computer or handwritten, is a critical management tool. Inventory and usage records can point out inefficiencies, theft and negligence. With today's narrow profit margins, correct inventory management is essential.

To ensure consumer confidence and maintain market share, producers must be able to document the use and safety of beef products. The industry must be able to prove it has tight control of risk factors with a residue potential through effective documentation. As a result, consumer confidence will be strengthened and regulatory pressures will be reduced.

Animal health products are costly items. Accurate records can highlight inefficiencies on an animal-by-animal basis and prevent ineffective administration of treatments. Furthermore, this information tells the veterinarian the treatments administered and allows for validation of treatment recommendations. This may require the veterinarian to adjust treatment regimens as animals and environmental conditions change. Records are very important to business success. Regulatory inspections by the FDA, USDA, EPA or OSHA will prove the necessity of good records. Effective documentation showing appropriate compliance with training, inventory control, use orders, animal identification, withdrawal and disposal will help avoid liability from a residue contamination. Should a feed yard be cited for a residue violation and that feed yard believes a mistake in identity has been made, good records may be the only proof of compliance. Records also will indicate the complete listing of pharmaceutical products used at the feed yard. Accusations that certain drugs have been used can be avoided when the feed yard can prove it does not use that specific compound.

Computer record systems make extensive evaluation easy and efficient; however, hand-kept record systems are still very effective. Each system has its own merits, so select the best system for your beef production unit.

Veterinary Drug Order

A Veterinary Drug Order (VDO) is a veterinarian-approved list of medications used in the operation and fits BQA guidelines (Figure 45.16).

The VDO should include all products that have a withdrawal time, including vaccines, antiparasitic drugs and all injectables (including vitamins). When all medications, vaccines, etc. are managed as if they are prescription items, an additional measure of quality assurance and safety is obtained.

All cattle medications and vaccines should be included on the VDO and should be updated at the same time the treatment protocol plan is updated.

Treatment Protocol Plan

Ask a veterinarian to develop a treatment protocol plan specific to the operation (Figures 45.17). Keep the treatment protocol plan on file at the treatment facility.

This concept of a treatment protocol plan may be more familiar to feed yards and larger stocker operations. However, it is a valuable management practice for cow-calf producers as well. It is simply writing a plan for what treatment(s) are to be used when cattle get sick for various reasons.

Also, write a plan for follow up and/or alternative treatments if the initial treatment does not produce the desired result.

The plan should be reviewed regularly and updated at least every 90 days or as often as is appropriate. When updating the protocol plan, previous versions also should be kept on file for a year or for reference for treatments that have worked in previous situations. When the plan is updated, it must have a veterinarian's signature and date recorded.

Accurate records also allow knowledge of exactly what is going into each animal or group of animals (Figure 45.18). This information prevents the re-administration of treatments that have previously failed to work. Furthermore, the information tells the consultant/veterinarian what treatments are being applied and what treatment recommendations are being followed to assess whether treatment regimens need to be adjusted.

Individual treatment records are useful for specific treatment of disease or injury to one specific animal. Group treatment records are used when vaccinations or mass medication treatments are administered to the herd. Both record types are similar, but it is important to maintain them separately for quick reference. This will make it easier for cattle to be checked and cleared to assure all withdrawal times have been met. A copy of all treatment records also should be transferred with the cattle at the point of sale, and buyers must be informed if cattle have not met withdrawal times.

Conclusion

Producers can have a positive impact on the quality and consistency of beef products by implementing BQA guidelines. The goal of the BQA program is to assure the consumer that all cattle shipped from a beef operation are healthy, wholesome and safe, and their management has met all government and industry standards.

References

Animal Drugs, Feeds and Related Products. 21 CFR pt.558 (1975).

Animal Drugs, Feeds and Related Products. 21 CFR pt.530 (1975).

Apple, J.K. (1999) Influence of Body Condition Score on Live and Carcass Value of Cull Beef Cows. *Journal of Animal Science* 77:2610-2620.

Boykin, C.A. et al. National Beef Quality Audit - 2016: In-plant survey of carcass characteristics related to quality, quantity, and value of dead steers and heifers. *Journal of Animal Science*. 2107.95:2993-3002.

Boyles, S. et al. (2001) Ohio Beef Quality Assurance. The Ohio State University.

Code of Federal Regulations, Title 21, chapter I, Subchapter E, Part 558
Code of Federal Regulations, Title 21, chapter I, Subchapter E, Part 530
Cundiff, L.V. et al. 2004. Germplasm Evaluation Program. Progress Report No. 22.
Eastwood, L.C. et al. National Beef Quality Audit -2016: Transportation, mobility and harvest-floor assessments of targeted characteristics that affect quality and value of cattle, carcasses and by-products. Transl. Anim. Sci.2017. 1:229-238.
FDA. 2015. #120 Guidance for Industry. Veterinary Feed Directive Regulation Questions and Answers. fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/ucm052660.pdf.(Accessed 8 September 2015.)
FDA. 2012. #209. Guidance for Industry. The Judicious Use of Medically Important Antimicrobial Drugs in Food Producing Animals.
FDA. 2013. #213. Guidance for Industry. New Animal Drugs and New Animal Generic Combination Products Administered in or on Medicated feed or Drinking Water of Food-Producing Animals: Recommendations. fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM299624.pdf. (Accessed 8 September 2015.)
Gray, G. D., M. C. Moore, D. S. Hale, C. R. Kerth, D. B. Griffin, J. W. Savell, C. R. Raines, T. E. Lawrence, K. E. Belk, D. R. Woerner, J. D. Tatum, D. L. VanOverbeke, G. G. Mafi, R. J. Delmore Jr., S. D. Shackelford, D. A. King, T. L. Wheeler, L. R. Meadows and M. E. O'Connor. 2012. National Beef Quality Audit - 2011: Survey of instrument grading assessments of beef carcass characteristics. *Journal of Animal Science* 90:5152-5158.
Guidance for Industry #120: Veterinary Feed Directive Regulation Questions and Answers.
Guidance for Industry #209: The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals.
Guidance for Industry #213: New Animal Drugs and New Animal Generic Combination Products Administered in or on Medicated Feed or Drinking Water of Food-Producing Animals: Recommendations.-
Hale, D. S. et al. 2007. National Market Cow and Bull Beef Quality Audit-2007: A Survey of Producer-Related Defects. Final Report to the National Cattlemen's Beef Association, Centennial, CO.
Harris, M.K. et al. National Beef Quality Audit -2016: Transportation, mobility, live cattle and carcass assessments of targeted producer-related characteristics that affect value of market cows and bulls, their carcass, and associated by-products. *Translational Animal Science*. 2017.1:570-584.
Kuehn, L. A. and R. M. Thallman. 2014. Across-Breed EPD tables for the Year 2014 Adjusted to Breed Differences for Birth Year of 2012. Proc. Beef Improvement Federation 46th Annual Research Symposium and Annual Meeting, Lincoln, Nebraska. June 18-21, 2014. pp 134-159.
Lalman, D. and R. Smith. (2000) Effects of Preconditioning on Health, Performance and Prices of Weaned Calves. OSU Fact Sheet ANSI-3529.
Moore M.C. et al. 2012. National Beef Quality Audit-2011: In-plant survey of targeted carcass characteristics related to quality, quantity, value, and marketing of fed steers and heifers. *Journal of Animal Science* 90:5143-5151.
Moore, M. C., G. D. Gray, D. S. Hale, C. R. Kerth, D. B. Griffin, J. W. Savell, C. R. Raines, K. E. Belk, D. R. Woerner, J. D. Tatum, J. L. Igo, D. L. VanOverbeke, G. G. Mafi, T. E. Lawrence, R. J. Delmore Jr., L. M. Christensen, S. D. Shackelford, D. A. King, T. L. Wheeler, L. R. Meadows and M. E. O'Connor. 2012. National Beef Quality Audit - 2011: In-plant survey of targeted carcass characteristics related to quality, quantity, value, and marketing of fed steers and heifers. *Journal of Animal Science* 90:5143-5151.
McKeith R.O. et al. 2012. National Beef Quality Audit-2011:Harvest-floor Assessments of Targeted Characteristics that Affect Quality and Value of Cattle, Carcasses and Byproducts. *Journal of Animal Science* 90:5135-5142.
McKenzie K. et al. National Beef Quality Audit-2016: Assessment of cattle hide characteristics, offal condemnations and carcass traits to determine the quality status of the market cow and bull beef industry. *Translational Animal Science*.2018.2:37-49
National Cattlemen's Beef Association. A Producer's Guide for Judicious Use of Antimicrobials in Cattle. (2001)
National Cattlemen's Beef Association. 2019: National Manual, Beef Quality Assurance Denver, Colorado. Accessed 4/27/20 and available atbqa.org/resources/manuals.
National Cattlemen's Beef Association. Beef Quality Assurance National Guidelines.(2001) Denver, Colorado.
Navigating Pathways to Success: 2016 National Beef Quality Audit Executive Summary: 2016 National Beef Quality Audit Executive Summary. Accessed 4/27/20 atbqa.org/national-beef-quality-audit.
Navigating Pathways to Success: 2016 National Beef Quality Audit - Market Cow and Bull Executive Summary. Accessed 4/27/20 at bqa.org/national-beef-quality-audit.
Smith, G.C. et al. (2000) National Beef Quality Audit. Improving the Quality Consistency, Competitiveness and Market Share of Fed-Beef. National Cattlemen's Beef Association.
USDA. 2006a. Performance requirements for instrument marbling evaluation (PRIME I). Demonstration of repeatability, accuracy, and precision. Livestock, Poultry, and Seed Program, Agricultural Marketing Services, USDA, Washington, DC.
USDA. 2006b. Performance requirements for Instrument Marbling Evaluation (PRIME II). Implementation and verification of operational procedures. Livestock, Poultry, and Seed Program, Agricultural Marketing Services, USDA, Washington, DC.
Woerner, D. R. and K. E. Belk. 2008. The history of instrument assessment of beef. Report submitted to the National Cattlemen's Beef Association, Denver, CO.

Veterinary Drug Order

The following products are to be used at_____.

Brand Name & Company	Lot Numbers	Number of Doses	Date Purchased	Dates Used	Withdrawal Time	Expiration Date

Figure 45.16. Example of a veterinary drug order. This form may be copied.

Treatment Protocol Plan

Disorder: _____

Indications for treatment (symptoms of affected animals): _____

_____

_____

_____

Primary Treatment

Product/active ingredient: _____

Dose: _____

Route of administration: _____

Duration/frequency of treatment: _____

Withdrawal period: _____

Other comments: _____

_____

_____

Secondary Treatment

Product/active ingredient: _____

Dose: _____

Route of administration: _____

Duration/frequency of treatment: _____

Withdrawal period: _____

Other comments: _____

_____

_____

Prevention

Product: _____

Dose: _____

Route of administration: _____

Withdrawal: _____

Special instructions: _____

_____

_____

_____

_____

_____

Veterinarian signature: _____

Figure 45.17. Example of a treatment protocol plan. This form may be copied.

Health Treatment Record for Cattle

ID/group description	Date of treatment	Comments/symptoms/ temperature	Product used	Serial/ lot numbers	Route[1] and location[2] of administration and dosage	Withdrawal date	Person giving treatment

[1] SQ (Subcutaneous); IM (Intramuscular); O (Oral).
[2] RN (Right Neck); RE (Right Ear); LN (Left Neck); LE (Left Ear).

Keep This Record for Three Years

Figure 46. 18. Example of a treatment record for cattle. This form may be copied.