# *Antibiotic Use, Food Safety, and Quality Assurance*

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Prudent and responsible use of antibiotics is a significant issue facing the dairy industry. There is no question that many animals benefit from the use of antibiotics for the treatment of infectious diseases. However, there are several concerns relative to food safety and quality assurance of milk and meat products that must be considered when using these drugs. Three of these concerns are 1) injection site lesions, 2) antibiotic residues, and 3) antibiotic resistance of bacteria. Misunderstanding of these issues and their relevance to antibiotic use in dairies can result in unfavorable public perception. Thus, it is important that dairy producers as well as the public have a common appreciation of how antibiotic use affects food safety and quality assurance.

**Injection Site Lesions**

Injection site lesions refer to the visible tissue damage resulting from both the mechanical and chemical irritation caused by the injection and the body's inflammatory response to this irritation. Injection site lesions can occur when any drug or biological (vaccine) is injected into an animal. In fact, simply injecting sterile saline can result in an injection site lesion. Injection site lesions result in increased trim from the carcass and decreased quality of the meat as far as 6 inches from the injection site. These lesions can be detected in the tissues for years after the injection. While injection site lesions can be minimized, they will never be eliminated with conventional injection techniques. Thus, it is critical from a quality assurance standpoint that subcutaneous and intramuscular injections be administered in the neck rather than other areas of higher quality cuts of beef. Even with this recommendation in place for nearly a decade, injection site lesions are still identified in the round of market dairy cattle. A carcass audit performed in 2000 still showed that 35% of market dairy cows had injection site lesions located in hind limb muscles.

Proper injection technique will help minimize injection site lesions. All injections should follow the manufacturer's recommendations in order to minimize these lesions. Larger needles cause more tissue trauma and tissue lesions. Thus, you should strive to use the smallest needle suitable for the drug and the route. Drugs that are more viscous (thicker) will require a larger bore needle than less viscous drugs. Intramuscular (IM) injections require longer needles (1 to 1 1/2inch) than do subcutaneous (SQ) injections (5/8 inch needles). Better animal restraint will reduce injection site lesions by minimizing movement and mechanical damage caused by the injection. Higher drug volumes cause greater tissue reaction and increase the potential for injection site lesions. All injections should be limited to no more than 10 cc (ml) per injection site location. Each injection site location should be separated by 4 inches or one hands breadth. Do not fan out your injection from one single site. If a drug is labeled for either IM or SQ injection it is better to administer it by the SQ route rather than the IM route as this will make lesions easier to identify at slaughter and reduce their damage to muscle tissues. Following these simple practices can greatly reduce the impact of injection site lesions on market dairy cattle.

**Antibiotic Residues**

Antibiotic residues refer to measurable amounts of drug that can be detected in tissues following administration of an antibiotic. Every antibiotic approved for food animal use has a "tolerance" level that is established by the Food and Drug Administration (FDA) and is defined as the maximum detectable drug concentration allowed in specific tissues at the time of slaughter. A drug tolerance level is established based on consideration of the potential risks to humans exposed to that drug in food. These health risks include allergic reactions (i.e. penicillin), bone marrow suppression (i.e. chloramphenicol, sulfonamides), nephrotoxicity (i.e. gentomycin), carcinogenicity (i.e. sulfonamides), or the potential for developing antibiotic resistant bacteria (i.e. all antibiotics).

Following administration of an antibiotic, the active chemical is eliminated from the body by several mechanisms that are specific for each type of drug. Meat and milk withdrawal times are established by the FDA based on the elimination of each drug in normal healthy animals and the tolerance limits. Drugs that are eliminated more slowly have longer withdrawal times. Some drugs have specific properties that delay their elimination. For example, aminoglycosides such as gentomycin bind to cells in the kidney and are eliminated very slowly resulting in detectable drug as long as 18 months after administration. This prolonged withdrawal period as well as potential health risks to humans is the basis for the voluntary ban on aminoglycoside use in cattle. This ban is supported by the National Cattlemen's Beef Association, the American Veterinary Medical Association, the American Association of Bovine Practitioners, and the American Society for Theriogenology.

Administration of a drug by a method or route different than that described on the label can alter the elimination of the drug and result in residues that exceed the tolerance limit after the recommended withdrawal times. A common example of this is the administration of antibiotics by a different route than described on the label (i.e. giving penicillin SQ rather than IM), or administering more than 10 cc (ml) per injection site. Administration of more drug than indicated on the label will also result in prolonged withdrawal times.

Since drug residues are a major quality assurance and food safety issue, routine procedures are in place both at the creamery and at the slaughter plant to detect residues in milk and meat. Dairy producers are well aware of the routine milk tests performed for detecting antibiotics. However, many producers are not aware of the procedures in place at the slaughter plant. In general, tissues from carcasses with injection site lesions are routinely identified and subjected to antibiotic testing at slaughter. In addition, tissues from random carcasses can also be tested. Carcasses with positive tests are condemned and the previous owner is notified. Repeated positive tests can result in penalties.

One of the focuses of Dairy Quality Assurance programs is to promote specific practices that will help minimize the risk of marketing food products from animals with drug residues. These practices include:

1. Proper labeling and storage of all drugs.
2. Only using drugs within labeled guidelines unless specifically prescribed by your veterinarian.
3. Individual identification of all animals.
4. Maintenance of animal records that will allow tracking of drug use.
5. Provide extended withdrawal times for milk and meat from animals treated in an extra label fashion (i.e. increased dosage, alternative route, extended duration of treatment).
6. Use of screening tests for milk or urine to detect antibiotic residues prior to shipping milk or sending animals to slaughter whenever antibiotics have been used in an extra label fashion.

**Antibiotic Resistance**

Antibiotic resistance refers to the ability of bacteria to loose their susceptibility to specific antibiotic drugs. Bacteria have many different mechanisms that allow them to become resistant to a specific antibiotic or to antibiotics of a common chemical group. Antibiotic resistance is conferred by variations in the genetic makeup of bacteria. The genes that confer antibiotic resistance are carried on the bacterial chromosome or on separate plasmids that can be transferred between different bacteria. Thus, one bacterium can transfer antibiotic resistance to another bacterium. In addition, genes that confer resistance to antibiotics tend to group together such that resistance to multiple antibiotics is transferred by a single plasmid. These properties of antibiotic resistance genes complicate the control of antibiotic resistance and contribute to the concern over the use of antibiotics in livestock and public health. For example, use of an antibiotic in one animal could select for a resistant population of bacteria that may not cause disease themselves but are able to transfer their resistance genes to another bacteria (i.e. *Salmonella spp*.) that can cause disease in both animals and humans.

Antibiotics can promote the establishment of an antibiotic resistant population of bacteria by killing the bacteria that are susceptible to the antibiotic but leaving behind the bacteria that are resistant. Antibiotics do not induce the genetic changes that confer resistance, rather, they select for the bacteria that already have the genetic changes responsible for resistance. Indiscriminant or inappropriate use of antibiotics can promote the selection of antibiotic resistant bacteria. Thus, it is extremely important that antibiotics are used appropriately and according to the manufacturer's recommendations unless otherwise specified by your veterinarian.

Resistance to some antibiotics is of greater food safety and public health concern than other antibiotics. Intestinal salmonellosis and campylobacteriosis are important food safety and public health concerns as they can cause severe and sometimes fatal disease in humans. Fluoroquinolone antibiotics are often required to successfully treat these diseases in humans. The potential for the development of resistant *Salmonella spp*. and *Campylobacter spp*. bacteria is the major reason why there is such concern over the use of fluoroquinolones in cattle. Thus, the fluoroquinolone drugs available for use in cattle, enrofloxacin (Baytril) and danofloxacin (A180) have very specific labels that restrict their use to the treatment of respiratory disease in beef cattle only (NOT for use in cattle intended for dairy production or in calves to be processed for veal). In addition, ANY extra label use of these two drugs in food producing animals is illegal. Thus, legal use of these drugs in a dairy is restricted to only steer calves meant for beef production or bulls that have respiratory disease. Treating a female dairy animal with these antibiotics, or treating any animal for a condition other than respiratory disease would be considered illegal.

**Conclusions**

It is important for dairy producers and dairy veterinarians to understand the terms and fundamental concerns related to antibiotic use in cattle. Appreciation of these factors will help the dairy industry take a leading role in making responsible antibiotic use decisions and policies for dairy cattle.