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## Managing for Today's Cattle Market and Beyond

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### *Cattle Marketing and Food Safety*

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#### **Introduction**

Common sense suggests and statistical research confirms that lapses in the management of food safety along the cattle-beef supply chain create many negative consequences for society. Consumers are put at a higher risk of foodborne illness or other types of contamination and may suffer symptoms that range from the inconvenient to the fatal. Those who suffer no personal damages may still undertake costly preventative measures and may even stop preparing, serving, and eating certain cuts of beef that they formerly enjoyed. Individual firms that trigger food safety lapses often receive tremendous negative attention and see their firm's market value dramatically decrease (Salin and Hooker).

Closures of slaughter and processing plants tainted by food safety outbreaks may decrease the number of outlets available in a geographic area. This decreases farmers' local access to customers and depresses local prices (Raper, et al.). Finally, all farms and firms that produce or distribute cattle or process and sell beef suffer because food safety recalls depress aggregate demand for beef, reducing profitability for all involved (Schroeder, et al.).

We focus on two related but distinct classes of food safety issues that currently vex the cattle and beef sector: **drug residues** and **microbiological contamination**. Potentially harmful residues occur when veterinary or animal husbandry treatments are used improperly during the lifetime of an animal

such that residues of the drug or hormone remain in the animal's system and emerge in the muscles or organs that are consumed by humans. Microbiological contamination occurs when pathogens such as *E. coli.*, *Salmonella*, or *Listeria* grow in or on processed cuts of beef. These pathogens, in particular *E. coli.*, are known to exist in the digestive tract of cattle, which is often the source of the microbes that appear on meat. However, the potential remains that pathogen-free cattle transported or co-mingled with infected cattle prior to slaughter, or previously "clean" carcasses, may become tainted with pathogens due to some form of environmental or cross contamination.

These two classes of food safety issues are alike in that both have their genesis during the "cattle" portion of the cattle-beef chain. Producers may introduce drugs or hormones either directly or through feed for numerous reasons and at various ages of an animal's life. Conversely, pathogens, such as *E. coli.*, may form in the digestive tract of cattle as they reach slaughter age. While residues (mostly antibiotics) remain a problem in high-risk cattle (cull, dairy, and veal calves), generally the industry has been successful in assuring compliance with best management practices and withdrawal periods (USDA). These chemical and microbiological hazards, along with concerns over physical hazards, are the focus of slaughter and processing plants when preparing their Hazard Analysis and Critical Control Point (HACCP) plans. Most frequently these plans

require a critical control point at the receiving dock, with increasing attention being placed on the plants' ability to determine the relative hazards placed on their system by different supplies of cattle.

Various farm-level efforts can be employed in an attempt to influence the food safety profile of cattle. These include feed and water controls, manure utilization, genetics/husbandry, the use of vaccines, housing, transportation, and herd management strategies as part of a broader quality assurance (QA) program. These system elements can affect the prevalence of drug residues, pathogenic, and spoilage organisms. As processors require more of their suppliers in a HACCP environment, so an enhanced level of information transfer must be incorporated into cattle marketing systems. Without such evidence, feedlots and farmers risk the rejection of whole lots or herds due to food safety concerns.

These two classes of food safety issues are also critically different with regard to at least two aspects. The first aspect is the potential for *information transparency*. Drug and hormone residues are introduced to the animal's system by its handlers; hence, if proper record keeping is maintained, this information should be transparent to all future owners of this animal and its meat products. Microbiological agents arise organically within an animal but not necessarily in response to any particular action taken by the animal handler. While scientists are currently trying to isolate management techniques that could reduce the probability of such digestive tract growth, it is unlikely that any handler will be able to provide perfect information to future owners concerning the status of microbiological activity of an animal's digestive tract. Marketing tools, therefore, must accommodate these information differences while aiding in the communication of the unique production techniques adopted by pro-active farmers or feedlots. Further, these marketing tools should provide feedback on the impacts of these QA programs on the meat-processing sector. For example, if a certain withdrawal period or feed regime provides the slaughter or processing plant with more flexibility in scheduling or utilizing capacity, this benefit needs to be shared with those producers able to assure such a level of quality. Thus, such marketing practices need to consist of more than the *risk shifting* element of "traceback"—often considered a negative term by producers—by facilitating true *risk sharing* via

"traceforward" or *identity preservation* (Hooker, et al.).

Second, these two classes of food safety issues are different because the impurities have *different dynamics* along the cattle-beef chain. Once drugs or hormones are introduced into a system, for example, the level of the undesired substance that stays with the animal follows a predictable pattern in which residue levels initially increase from the substance-free state to a state of maximum saturation. For most drugs, after some critical time period, the substance leaves the system. Hence, the amount of the substance that will appear in particular beef cuts is largely predictable and the misuse of injected drugs is often detectable to the processor. The introduction of microbiological agents into an animal's system, however, is not so predictable and the processor does not easily detect microbiological activity. The size of the population of pathogens in an animal and on a particular beef cut or in ground beef is subject to many parameters such as temperature, pH, and salinity. So, the population of microbes could either grow or shrink through time depending on subsequent actions. Furthermore, environmental contamination within a slaughter or processing plant could introduce more or new pathogens onto the carcass, making it difficult to forecast the growth of different populations and the ambient risk faced by a final consumer of a product. This also makes it more difficult to pinpoint which link along the cattle-beef chain was at fault if contaminated product does emerge. Finally, many low to moderate levels of microbiological contamination may be effectively eliminated by the end consumer with proper preparation techniques, while such remedies do not exist in the case of drug residues.

Issues surrounding animal production food safety in the cattle and beef sectors are particularly difficult to resolve because of the interconnected nature described in the previous paragraphs. QA efforts along the cattle-beef chain to the consumer's plate are only as good as the quality control provided by the *weakest link*, but all the players along the chain may suffer if that weakest link breaks. Therefore, resolution of QA issues requires a systematic approach, but such a solution is difficult to coordinate because ownership transfers many times along a typical production/processing chain. Furthermore, particularly in the case of microbiological concerns, identifying the weakest

link is difficult because there may exist missteps at each link in the chain and accurate information concerning the exact status of the product at each step is usually not available. Conversely, this makes it difficult for players along the chain to obtain a premium for their individual QA efforts.

Buyers may induce appropriate QA activities of suppliers by using *incentives* for desired actions or by imposing economic *sanctions* on those found to have poor quality control. Both mechanisms require information to assess quality. In the case of incentives, the information usually takes the form of records that document and certify the handling procedures used by the supplier, such as the date, type, and location of any drug or hormone injections. If veterinary and animal scientists can identify and validate management practices that reduce digestive tract *E. coli.* populations, such certification procedures may also be the basis of QA incentive premiums to the supplier. In lieu of such preventative management practices, the only alternative for incentive payments would rest with the testing of incoming cattle by the buyer. Testing of all animals is unlikely to be cost effective; hence, some type of random sampling may be used.

Imposition of penalties for poor quality is the alternative incentive mechanism. This requires a slightly different type of information. It involves some mechanism which

- identifies the QA problem at some point in the chain (e.g., random testing of carcasses for *E. coli.* or residues or traceback from a reported foodborne illness outbreak),
- links the defective product to each handler along the cattle-beef chain (e.g., DNA “fingerprinting” techniques), and
- distinguishes the individual that introduced the contamination into the product (e.g., electronic ear tag records).

Any such mechanism would have a large data requirement and, quite possibly, would require some alteration to the processing chain to avoid the intermingling of product sourced from different suppliers.

### *Existing Quality Assurance Programs on Farms and Feedlots*

One way to categorize the early efforts in producer-level QA programs is by asking who is

taking the lead—is the program in the public or private realm? To date we have seen a range of programs adopted by producer groups or agribusinesses independently. For example, a particular cattle-beef chain may require certain feed withdrawal periods prior to delivery at a slaughterhouse, restrict allowable feedstuffs and growth implant treatments, or conduct on-site verification activities of residue management programs. These activities are generally designed around the Beef Quality Assurance (BQA) program of National Cattleman’s Beef Association and are largely voluntary, though some are also established by particular branded beef chains and are mandatory (e.g., Laura’s Lean Beef).

The BQA program originated in 1986 as a voluntary initiative. A major reason for its implementation was to regain the trust and confidence of the consumer and to maintain product accountability. The program was developed by producers for producers, which is probably the cause for its overwhelming success. This success is demonstrated by the fact that 98% of animals coming out of feedlots and 90% from farms are from states with BQA programs. The National Cattlemen’s Beef Association provides technical support and national leadership; however, the program is implemented on a state-by-state basis. Each state has its own unique BQA program. Different states began their programs at different times, usually when funding for a state beef council or state cattlemen’s association allowed.

Generally, the BQA program uses handbooks, videos, workshops, and demonstrations to stress the importance of developing safety and quality guidelines for producers. Education on proper animal health product use, environmental management, record keeping, and feed additives are all important aspects of the BQA program. Some states require that producers complete two or three levels of training to be BQA certified while others have only one level of certification. Within the BQA program, all producers are educated on the importance of proper and safe animal drug use, on adherence to product label withdrawal periods, and on record keeping for animal product use, drug inventories, and animal treatments. This is all intended to reduce the occurrence of drug residues in beef products.

**Table 1. National Cattlemen’s Beef Quality Assurance Program Overview and Example Guidelines.**

<b>Management Areas Covered</b>	<b>Example Guidelines</b>
Feedstuffs	Maintain records of any pesticide/herbicide use on pasture or crops that could potentially lead to violative residues in grazing cattle or feedlot cattle.
Feed Additives and Medicines	Operator will assure that all additives are withdrawn at the proper time to avoid violative residues.
Processing/Treatment and Records	All processing and treatment records should be transferred with the cattle to next production level. Prospective buyers must be informed of any cattle that have not met withdrawal times.
Injectable Animal Health Products	No more than 10 cc of product is administered per intra-muscular injection site.
Care and Husbandry Practices	All cattle will be handled/transported in such a fashion to minimize stress, injury and/or bruising.

However, the BQA-based programs only require that producers have undertaken certain (individual) education courses and these programs remain voluntary. Voluntary programs, in practice, do not induce farmers to vigilantly comply with all program guidelines. For the argument raised above, it appears likely that some form of third party certification will be required as we see an increasing attention placed on pathogen reduction strategies on-farm. These third party agents may be veterinarians or extension agents. This aspect is likely to become increasingly important in securing market access for our exports (USDA).

A second useful tool to categorize QA programs is by the hazards addressed. As discussed earlier, the two primary food safety concerns in the cattle-beef chain are chemical and microbiological. However, at the same time, one should not forget about the physical hazards that may either influence the safety of the final food (e.g., contamination with needle fragments from drug treatments). The focus of the large majority of QA efforts, to this stage, is violative chemical residues. It is relatively easy to implement and monitor a residue program, and most producers have become well versed in the benefits of close cooperation with slaughter plants. Injection site protocols and withdrawal periods have reduced physical and chemical hazards in slaughter cattle while enhancing other meat attributes (e.g., reduced bruising and a closer tracking of eating quality measures). It is less clear what QA efforts are effective in addressing microbiological hazards.

However, as controls (e.g., pathogen specific vaccinations and pathogen minimizing handling and feeding practices) become viable, we can expect additions to the BQA program that provide guidance on what farmers can do to help minimize the occurrence of these hazards.

***The Benefits and Costs of  
Quality Assurance Programs***

Once the administrative structure and goal of the QA program has been determined, it is vital that the degree of specificity in production practices be assessed, for this will be a key factor in forecasting the costs of the program. The majority of required alterations to meet BQA program specifications are those of record keeping and proper animal health product usage. Record keeping requires not only extra materials, either in paper or computer space form, but also time and managerial attention. Some of this time and effort may be discretionary; i.e., it does not compete with time and effort the producer currently dedicates to work cattle. At least some of the additional effort and time will directly compete with cattle handling time and inevitably slow the handling and movement of animals unless large capital expenditures are made to fully automate data collection and to streamline processes to verify that all animals have met BQA standards. Furthermore, if a producer currently relies upon off-label use of certain animal health treatments or feed additives that would not be approved under BQA programs, or if

the producer follows unapproved drug injection practices, changes must be implemented to follow approved practices and uses.

For a successful QA program that can be enforced at all levels of production, an effective animal identification program is necessary. Currently, the level of cattle identification is simply through eartags that are tamper-resistant and provide unique identification of the animal conforming to the alphanumeric National Uniform Eartagging System or bear a valid premises identification number that is used according to an individual producer's livestock production numbering system. These eartags serve to identify the animals, but animals tend to have many different identification numbers for purposes on the farm, which can lead to confusion of identification. The USDA is currently working on a program to improve livestock identification for interstate and international trade, food safety, genetic evaluation, and animal health purposes. This program will likely use a universal identification system reducing the need for multiple identification methods.

Regardless of the efforts made by farmers or feedlots to address microbial hazards, and even with complex animal identification systems that are able to identify preserve production characteristics, many additional problems can still arise prior to slaughter. Many lots of cattle are co-mingled during the marketing process, either in traditional terminal markets, during transportation to or from a feeder, or at the holding pens of the slaughter plant. Certain aspects of this supply chain are currently being assessed for their impact on microbiological hazards (e.g., distance to slaughter plant and shedding rates for *E. coli.*, which can increase the pathogen presence on hides). It appears likely that many conventional cattle marketing practices increase microbial hazards, and therefore require further evaluation. Solutions may include direct delivery, increased segmentation of lots, different transportation logistics, or simply closer monitoring of hide cleanliness prior to slaughter.

Given the "weakest link" argument made above, it is clear that the tighter control of effective production or in-distribution practices that can reduce the occurrence of food safety hazards will lead to a set of pooled benefits for all associated agribusinesses in the cattle-beef supply chain. By promoting QA programs, societal goals of a safer food supply and more efficient monitoring activities,

and industry goals of enhanced reputation, secured market access, reduced recall, lower insurance costs, and product waste can all be met.

A valid concern of many cattle farmers is that if the benefits of such enhanced animal production food safety systems are mostly at the societal level (through reduced foodborne illness or adverse reactions to chemical contamination) then why are so many costs borne by their segment of the supply chain? Evidence from the swine industry may suggest that this should be anticipated. The pork quality assurance program is now considered by many "the cost of doing business" or a *de facto* standard. Producers have little choice but to adopt the Pork QA program if they wish to serve the mainstream supply-chain. However, while certain recurring and variable costs may rise for producers when complying with a BQA-based system, so too will costs for slaughter and processing plants. The technical ability of transfer of identity from cattle to the carcass and on to individual cuts of meat will require substantial fixed and variable costs. Electronic scanners, labels that can be attached to carcasses and cuts, information management systems, and potentially larger labor requirements are likely to arise. Therefore, when assessing the chain-wide impacts of responses to food safety challenges, one must aggregate over all of these costs, and not simply focus on a single sector. Once each of these costs is considered, a larger final (consumer) premium must exist and be sufficient to make the process viable.

### ***Potential Directions and Implications of Future Programs***

We believe that there will be an increasing demand for QA programs as slaughter and processing plants recognize that such programs increase their ability to respond to changing consumer demands and to reduce costs and losses during food recalls. One implication of this growing importance of QA is that it is likely to lead to greater vertical coordination along the production chain and, hence, the continued circumvention of terminal markets. The increased reliance on "captive" or contract supplies appears inevitable, as we require so much more information to be transferred between producers and their customers. This dynamic will clearly drive a wider wedge between prices in the "live" and "quality" market, perhaps causing more concern over the

current reliance on a relatively “thin” open market structure to discover prices for these contracts.

Furthermore, QA programs serve as a primer for other types of programs that producers might choose to follow in order to market products to niche markets. For example, the American Humane Association now offers a “Free Farmed” certification program that identifies animal products originating from animals farmed under a set of production guidelines that satisfy animal welfare concerns. The standards are based upon the British-based Royal Society for the Prevention of Cruelty to Animals Guidelines and the Federation of Animal Science Societies Guide and involve issues of environmental stewardship as well as animal welfare. This program was introduced in September of 2000 and involves third-party certification of production practices that is paid for by the producer via a one-time certification fee and per-animal fees. USDA’s Agricultural Marketing Service verifies that the third-party certification is legitimate by re-inspecting a percentage of all producers. Guidelines have been issued for beef cattle production, as well dairy, broiler, and egg production, and typically require strict minimum limits for per-animal feeding and living space. The method of verification—a producer-funded, third party, on-site inspection validated by USDA spot checks—may foreshadow the verification system for all future QA programs.

The ability of QA programs to influence the country of origin of beef offered to the US consumer and other nations’ efforts to use country of origin as trade barriers for US beef exports needs to be further assessed. Current proposed legislation in Congress would implement country of origin labels on most raw food products. Will this help or hurt the move towards QA programs? Would such regulations be challenged under the World Trade Organization? What will the resultant trade flows look like? These difficult questions need to be answered.

Animal identification issues are discussed in another paper in this section, so we do not expand upon them here other than to state that many food safety programs rely on identity preservation. However, there remain many technical limitations to physically transfer the identity of cattle from carcass to beef cuts. The high (fixed, non-recurring) costs of identity preservation may not be justified by a single quality attribute or offset by any premiums made available in the short-run. Therefore, only a vertically

coordinated system may be able to collect enough short- and long-run benefits from all segments of the production and marketing chain to justify the costs associated with the private implementation of an identity preservation and quality control program.

## Conclusions

We have provided a brief overview of the importance of food safety in cattle marketing today and our forecasts of its increasing role and forms in the coming years. Many cattle producers have demonstrated a desire and ability to address chemical residue concerns by voluntarily adopting producer-designed QA programs. We anticipate future activity will expand to encompass microbiological hazards once proven control methods emerge. We believe this will quicken the current trend in which fewer cattle are exchanged in traditional terminal markets and more cattle are transacted via contractual arrangement. Such a trend facilitates quality control efforts because production history is transferred with the cattle and facilitates reward sharing among all participants in the cattle-beef chain.

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