

# Beef Quality Assurance - Adding Value with E. coli Food Safety Focus

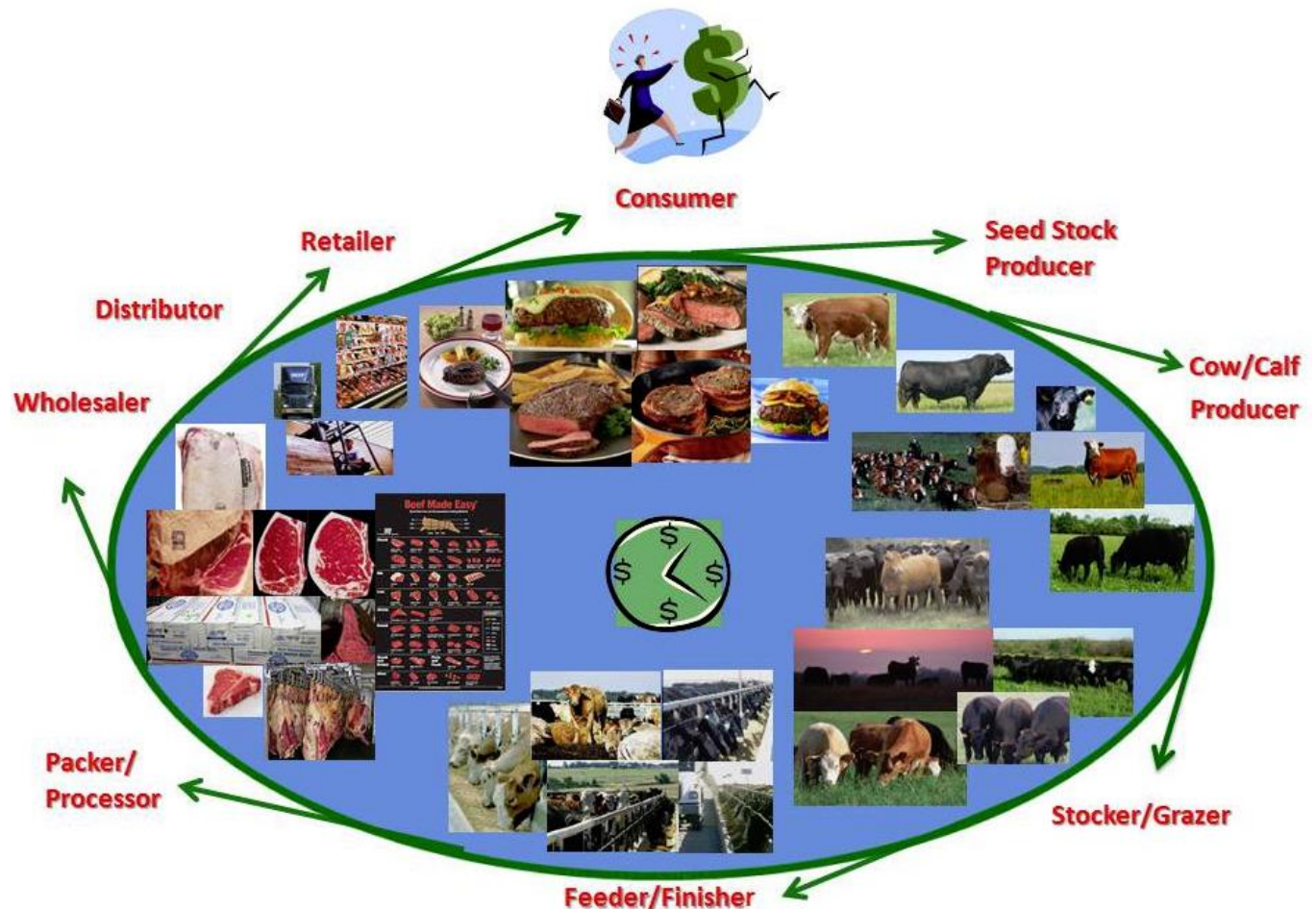


## Webb Flowers

### Introduction

#### **Beef Quality Assurance Adds Value for each Production Sector through Harvest and on to the Consumer.**

Adding value through Beef Quality Assurance (BQA) practices helps each successive sector start with an opportunity to make a profit with cattle that are healthier, are less stressed, have a stronger immune system, and have potential to provide end-product that has ideal carcass quality, yield, tenderness, wholesomeness, food safety and consumer acceptance.



#### **Adding Value through Beef Quality Assurance Benefits All Sectors**

“Doing the right thing” is a continuing theme for Beef Quality Assurance success even when some sectors are experiencing negative profitability! Quality assurance and BQA consistency is now a built in expectation by all sectors as demonstraighted

in figure 1 above and ultimately by the consumer. Very seldom do all sectors experience profitability simultaneously.

It is safe to assume that as beef producers began practicing and participating in BQA Certification in the 1990s, that producers did not automatically receive premiums for the BQA practices that were implemented and practiced.

So why do beef producers continue to participate in BQA?

**“Doing the right thing”** as recommended by cumulative results of successive National Beef Quality Audits 1990–2010 is demonstrating positive end product quality, wholesomeness and food safety progress. As producers continued to utilize BQA practices over a 10-20 year period during the 1990s and 2000s, and included additional value added practices, they began to realize premiums for BQA practices.

The focus of this publication is the importance of minimizing opportunities for foodborne illness pathogen to occur throughout the life of beef cattle for ***young calves through harvest.***

## **Primary Foodborne Illness Pathogens Impacting Beef:**

### ***Escherichia coli* O157:H7 and other Shiga toxin-producing *Escherichia coli* (STEC)**

#### **Why is the *E. coli* O157:H7 bacterium of special concern in ground beef?**

*E. coli* O157:H7 can colonize in the intestines of animals, which could contaminate muscle meat at slaughter.

O157:H7 is a strain of *E. coli* that produces large quantities of a potent toxin that forms in the intestine and causes severe damage to the lining of the intestine. The disease produced by the bacteria is called Hemorrhagic Colitis.

*E. coli* O157:H7 bacteria survive refrigerator and freezer temperatures. Once they get in food, they can multiply very slowly at temperatures as low as 44 °F. The actual infectious dose is unknown, but most scientists believe it takes only a small number of this strain of *E. coli* to cause serious illness and even death, especially in children. The bacteria are killed by thorough cooking with 160 ° F for hamburger patties 3-5 minutes per side and 145 ° F for whole muscle cuts with varying cooking times depending on cut size, thickness and weight.

Illnesses caused by *E. coli* O157:H7 have been linked with the consumption of undercooked ground beef, undercooked roast beef, sausages, raw milk, unpasteurized apple cider, fresh lettuce, fresh spinach, cantaloupe, cheese, mushrooms, alfalfa and radish sprouts and unchlorinated water.

All humans and animals carry the bacteria called *Escherichia coli* (*E.coli*) in their intestines – they are part of our normal flora and are usually harmless. However, there are certain types of *E. coli* strains that are a risk to human health including

those that are capable of producing toxins. These strains are called STEC/VTEC (shiga toxin or verotoxin-producing *E. coli*) or EHEC (enterohaemorrhagic *E. coli*), and their toxins have the potential to cause bloody diarrhea and Haemolytic Uremic Syndrome (HUS), a serious complication that can be fatal.



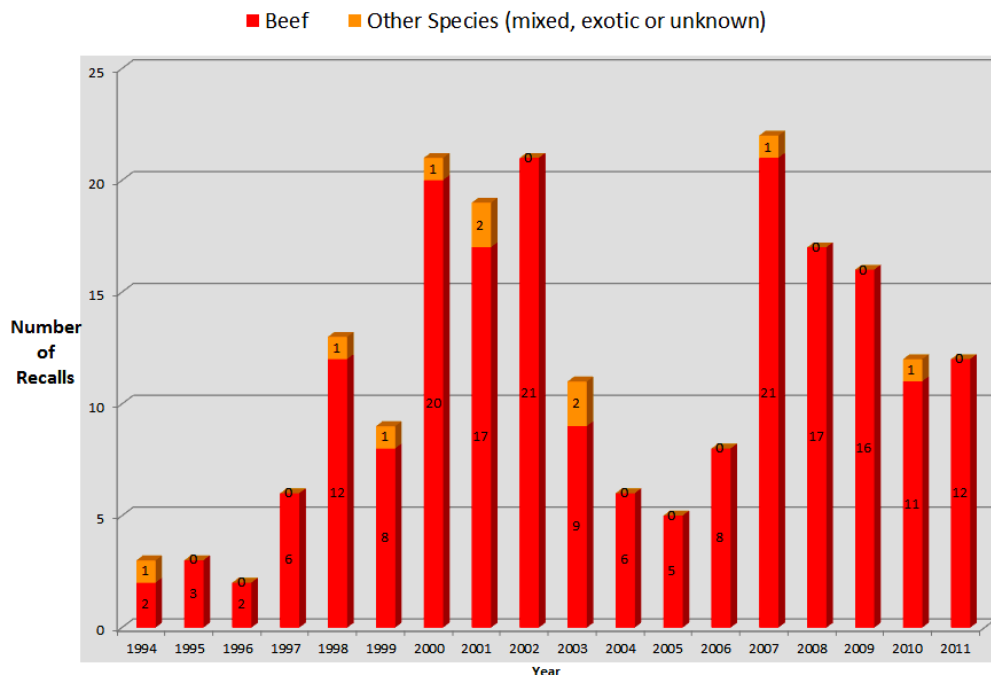
*E. coli* O157:H7

*E. coli* O157:H7

### History of *E. coli*, foodborne pathogen in beef

In 1993 the United States became aware of of toxin-producing *E. coli* O157:H7 due to an outbreak that gave 41 people HUS (haemolytic uraemic syndrome). That event occurred in hamburger meat from Jack in the Box fast-food chain infected with *E. coli* O157:H7. Even though significant reduction of *E. coli* infections is being made, the meat and food industry is still challenged by *E. coli* O157:H7, other STEC sero-types and other pathogens and contaminants. The three charts below give perspective for the beef industry 1994-2011 on the number of recalls, pounds of recalls in thousand due to *E. coli*, Listeria, Salmonella, Undeclared Allergens, Extraneous Materials and All Other.

**Number of *E. coli* Recalls for Beef and Other Meat Species**

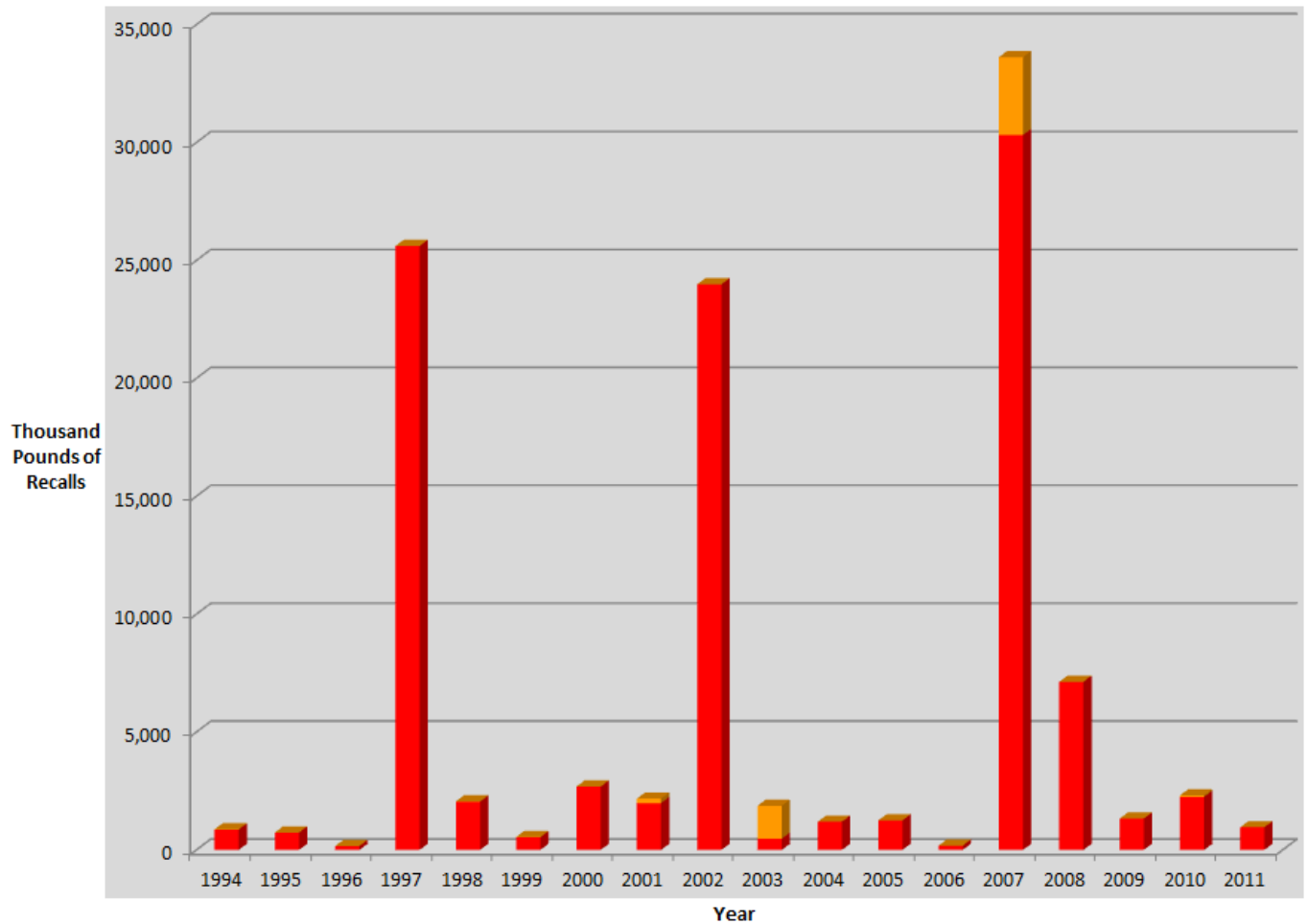


E. coli O157:H7 Recalls, Pounds	1994	1995	1996	1997	1998	1999	2000	1994-2000
Total E. coli Recalls All Species	873,349	735,956	163,539	25,613,978	2,058,325	551,446	2,689,040	32,685,633
Beef E. coli Recalls	863,349	735,956	163,539	25,613,978	2,043,325	538,446	2,684,740	32,643,333
Other Species E. coli Recalls (Mixed, Exotic or Unknown)	10,000	0	0	0	15,000	13,000	4,300	42,300

E. coli O157:H7 Recalls, Pounds	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total 2001-2011	Total 1994-2011
Total E. coli Recalls All Species	2,175,522	23,984,590	1,872,746	1,198,600	1,248,450	181,900	33,617,751	7,129,588	1,326,820	2,312,647	962,023	76,010,637	108,696,270
Beef E. coli Recalls	1,983,922	23,984,590	474,746	1,198,600	1,248,450	181,900	30,317,751	7,129,588	1,326,820	2,246,647	962,023	71,055,037	103,698,370
Other Species E. coli Recalls (Mixed, Exotic or Unknown)	191,600	0	1,398,000	0	0	0	3,300,000	0	0	66,000	0	4,955,600	4,997,900

### Thousand Pounds of E. coli Recalls

■ Beef ■ Other Meat Species (mixed, exotic or unknown)

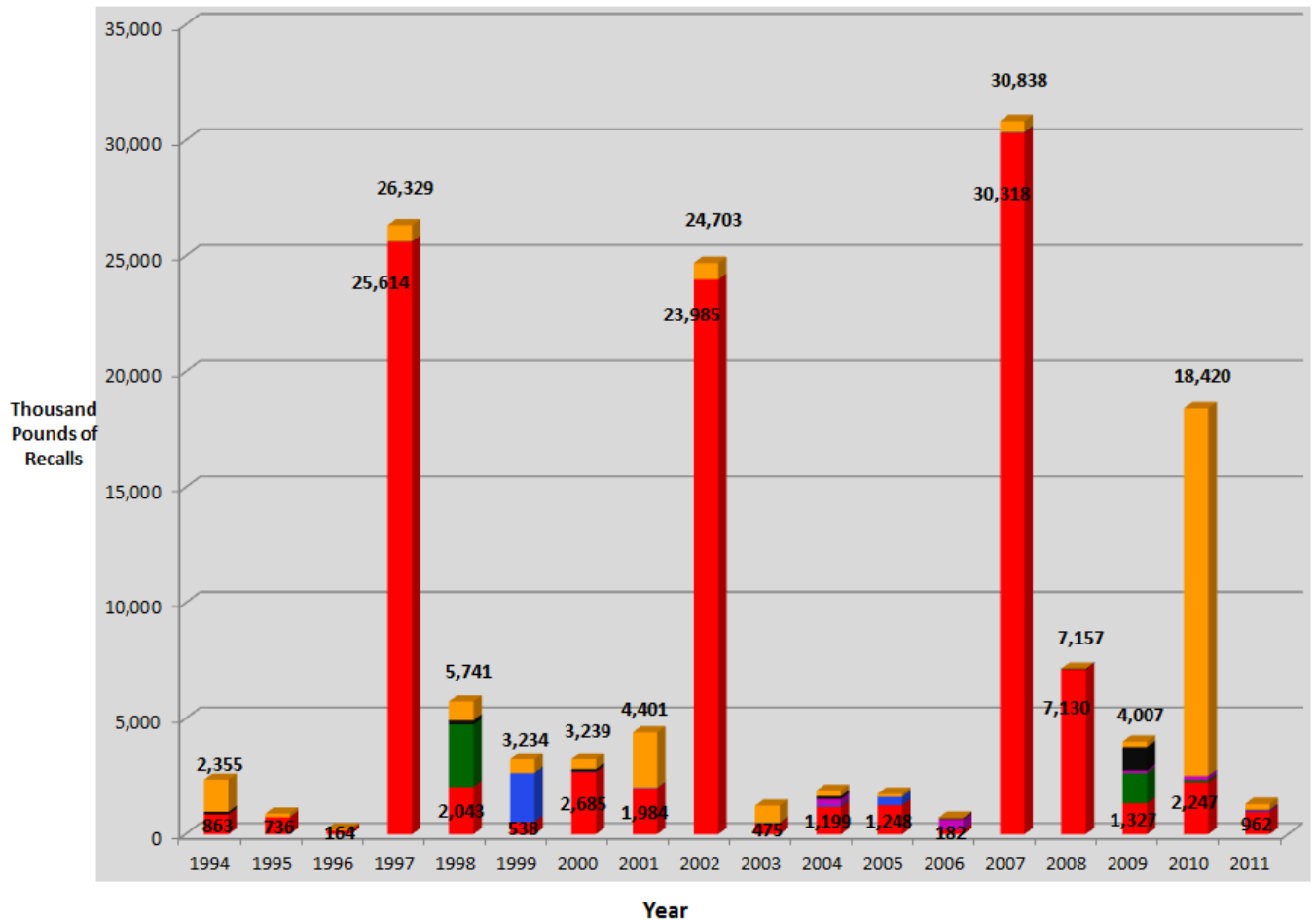


Reasons For Beef Recalls, Pounds	1994	1995	1996	1997	1998	1999	2000	1994-2000
E. coli	863,349	735,956	163,539	25,613,978	2,043,325	538,446	2,684,740	32,643,333
Listeria monocytogenes	4,088	4,510	4,175	0	3,600	2,100,000	16,906	2,133,279
Salmonella	0	0	0	0	2,700,000	0	0	2,700,000
Undeclared Allergens	0	0	0	0	0	0	0	0
Extraneous Material	99,144	0	0	8,484	179,188	10,000	109,000	405,816
All Other	1,388,152	150,000	45,180	706,955	814,667	585,264	428,000	4,118,218
<b>Total Beef Recalls</b>	<b>2,354,733</b>	<b>890,466</b>	<b>212,894</b>	<b>26,329,417</b>	<b>5,740,780</b>	<b>3,233,710</b>	<b>3,238,646</b>	<b>42,000,646</b>

Reasons For Beef Recalls, Pounds	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total 2001-2011	Total 1994-2011
E. coli	1,983,922	23,984,590	474,746	1,198,600	1,248,450	181,900	30,317,751	7,129,588	1,326,820	2,246,647	962,023	71,055,037	103,698,370
Listeria monocytogenes	20,670	226	2,586	57,320	370,712	100	15,602	5,250	2,489	0	23,775	498,730	2,632,009
Salmonella	0	450	22,000	0	0	0	0	0	1,314,728	92,000	126	1,429,304	4,129,304
Undeclared Allergens	0	0	0	270,160	2,845	466,381	5,084	0	105,034	178,763	39,556	1,067,823	1,067,823
Extraneous Material	0	0	0	118,000	0	48,588	15,000	22,481	1,028,290	2,740	22,570	1,257,669	1,663,485
All Other	2,396,103	717,968	734,131	236,490	124,850	24,184	484,909	144,734,064	229,483	15,900,300	259,086	165,841,568	169,959,786
<b>Total Beef Recalls</b>	<b>4,400,695</b>	<b>24,703,234</b>	<b>1,233,463</b>	<b>1,880,570</b>	<b>1,746,857</b>	<b>721,153</b>	<b>30,838,346</b>	<b>151,891,383</b>	<b>4,006,844</b>	<b>18,420,450</b>	<b>1,307,136</b>	<b>241,150,131</b>	<b>283,150,777</b>

### Reasons for Beef Recalls in Thousand Pounds

■ E. coli  
 ■ Listeria monocytogenes  
 ■ Salmonella  
 ■ Undeclared Allergens  
 ■ Extraneous Material  
 ■ All Other



In the chart immediately above, 2008 All Other Beef Recalls are omitted for display purposes. In 2008, Hallmark/Westland Meat Packing voluntarily recalled 143,383,823 pounds of beef due to not receiving complete and proper inspection of downer cattle prior to slaughter. Including the All Other Beef Recalls category for 2008 causes all other years to be graphically indecipherable.

Data Source for Charts: Food Safety and Inspection Service

### **So, what is the deal with E. Coli?**

Of the total **108, 696,370** pounds all meat recalled due to E. coli contamination from 1994 through 2011, **103,698,370** was in beef. From 1994 – 2011 there were four years with exceptionally high level recalls in beef: 1997, 2002, 2007 and 2008. 2010 revealed a different STEC serotype *E. coli* O26. The following are accountings of the larger recalls during the worst recall event years.

- August 8, 1997, Hudson Foods, Columbus NE., is voluntarily recalling approximately 25 million pounds of ground beef products because they may be contaminated with *E coli* O157:H7.
- October 2, 2002, Emmpak Foods, Inc., Milwaukee, WI., is voluntarily recalling approximately 19 million pounds of ground beef and beef trimming products because they may be contaminated with *E coli* O157:H7.
- July 19, 2002, Con Agra Beef Co., Greeley, CO., is voluntarily recalling approximately 2.8 million pounds of ground beef products because they may be contaminated with *E coli* O157:H7.
- June 9, 2007, United Food Group, LLC, a Vernon, Calif., establishment, is voluntarily expanding its June 3 and 6 recalls to include a total of approximately 5.7 million pounds of both fresh and frozen ground beef products produced between April 6 and April 20 because they may be contaminated with *E. coli* O157:H7.
- October 6, 2007, Topp's Meat Co., LLC, Elizabeth, NJ., voluntarily expanded its Sept. 25, 2007 recall to include a total of approximately 21.7 million pounds of frozen ground beef products because they may be contaminated with *E. coli* O157:H7.
- October 6, 2007, Cargill Meat Solutions Corporation is voluntarily recalling approximately 845,000 pounds of frozen ground beef patties produced at its Butler, Wis., location because they may be contaminated with *E. coli* O157:H7.
- November 1, 2007, General Mills Operations, a Wellston, Ohio, establishment, is voluntarily recalling approximately 3.3 million pounds of



frozen meat pizza products because they may be contaminated with *E. coli* O157:H7

- November 3, 2007, Cargill Meat Solutions Corp., a Wyalusing, Pa., firm, is voluntarily recalling approximately 1,084,384 pounds of ground beef products because they may be contaminated with *E. coli* O157:H7.
- August 14, 2008, Nebraska Beef, Ltd., an Omaha, Neb., establishment, is clarifying information from and expanding its recall announced on Aug. 8 of primal cuts, subprimal cuts and boxed beef to include such products bearing the company name "Nebraska Beef Ltd" that may be contaminated with *E. coli* O157:H7. The total amount of product subject to recall is approximately 1.36 million pounds.
- August 6, 2010, Valley Meat Company, a Modesto, Calif. establishment, is recalling approximately one million pounds of frozen ground beef patties and bulk ground beef products that may be contaminated with *E. coli* O157:H7.
- August 28, 2010, Cargill Meat Solutions Corp., a Wyalusing, Pa. establishment, is recalling approximately 8,500 pounds of ground beef products that may be contaminated with *E. coli* O26.

*E. coli* O26 is one of the seven strains of *Escherichia coli* (*E. coli*) that is extremely dangerous to humans. The most prevalent strain of shiga-toxin producing *E. coli* is O157:H7, which is classified as an 'adulterant' by USDA, meaning that it is tested for, and if its presence is detected, the food is held and/or recalled. The other six strains - O26, O45, O111, O121, O145, and O103 also cause severe illnesses, but have not yet been accepted as adulterants despite great efforts by the food safety community.

Source: FSIS

Dr. James Marsden, Meat Scientist with the Food Science Institute at Kansas State University, made the following timely and pertinent points regarding *E. coli* O104:H4 in his MeatingPlace blog, Safety Zone: The War on *E. coli* – The Next Decisive Step on June 20, 2011.

"During the height of the recent outbreak of *E. coli* O104:H4 in Europe, I heard the question asked in the media – "Can it happen here"? Of course, the answer is that it already has happened here – repeatedly.

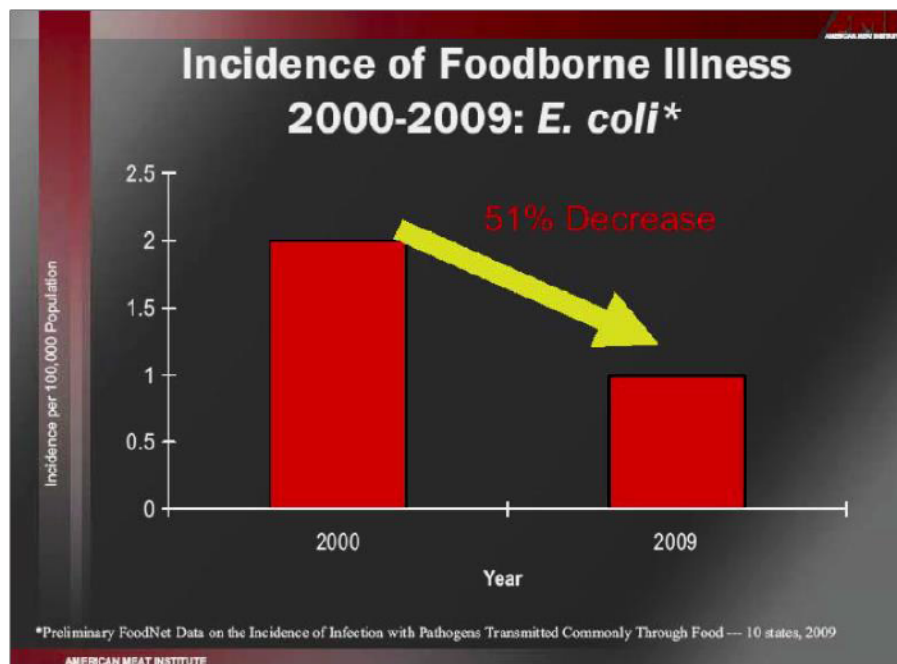
The outbreak in Europe and continued public health problems in the United States, including problems associated with beef products, serve as a reminder that the war on *E. coli* is not over. Unfortunately, we now have a host of STEC's to worry about - it's not just about controlling *E. coli* O157:H7 anymore.

Perhaps one of the biggest issues still remaining is the fact that cattle continue to be a major reservoir for hemorrhagic strains of E. coli. Contamination of leafy green vegetables and other non-beef food products may result indirectly from cattle.

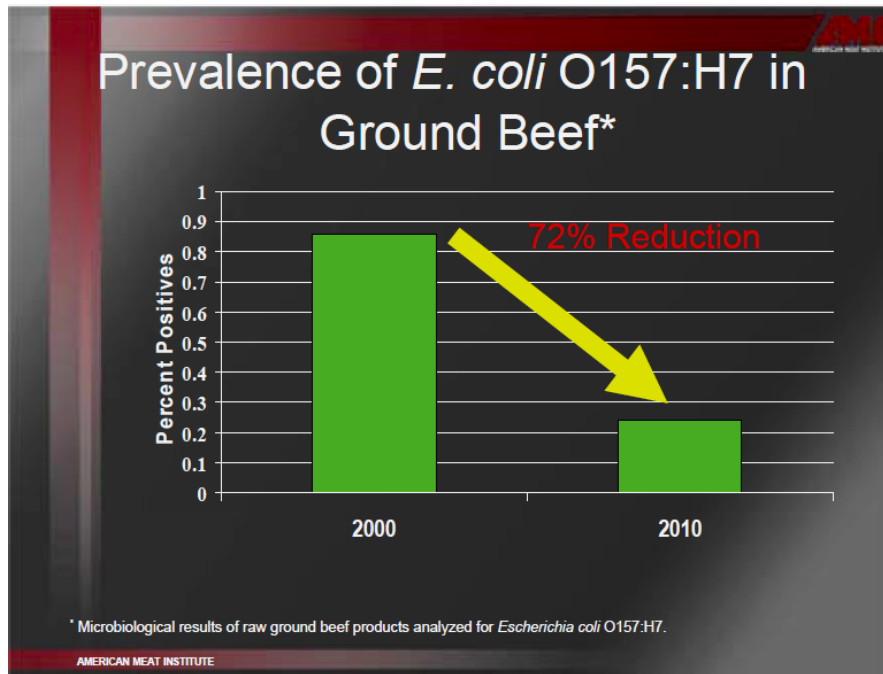
In order to truly solve the E. coli problem here and around the world, something has to be done to reduce or eliminate these types of pathogenic E. coli strains from live cattle.

The only way to accomplish this is through a vaccine or vaccines that are specific against E. coli O157:H7 and other STEC's. Additional pre-harvest technologies including Probiotics and the application of an E. coli specific Bacteriophage prior to slaughter may also be necessary."

**Even though we are benefiting from reductions in E. coli occurrences and prevalence in recent years as demonstrated in the following two American Meat Institute charts below, there is ample room for even greater reductions.**

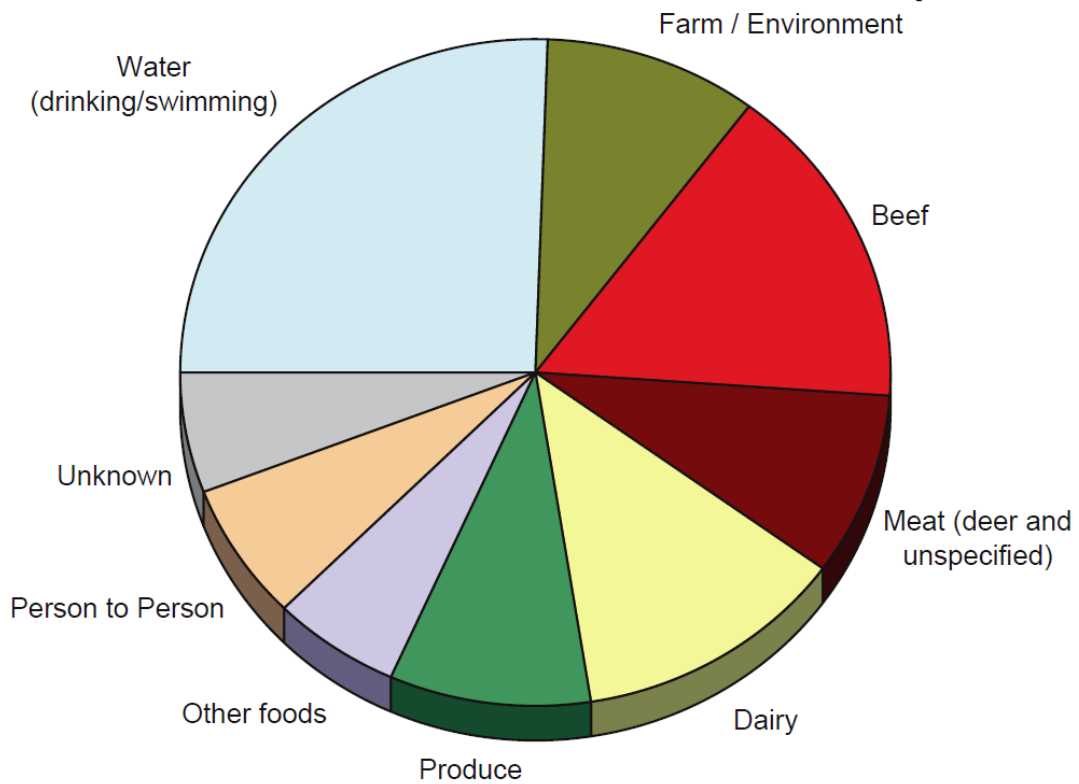






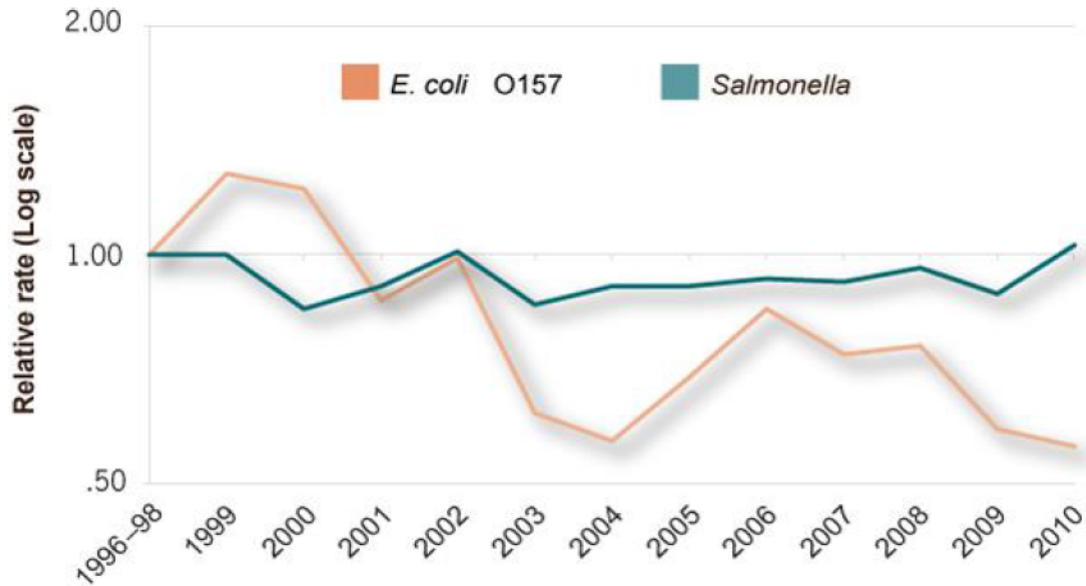
Source American Meat Institute

### *E. coli* O157:H7 Outbreaks Worldwide, 1982-present



Source American Meat Institute

Change in *E. coli* O157 and *Salmonella* infection, 1996–2010 (CDC: Vital Signs 2011)



## **What is on the Horizon for E. Coli?**

Food Safety News November 11, 2011 News Desk 'Big Six' E. Coli Policy: More Positives, Expert Predicts "Under the U.S. Department of Agriculture's soon-to-be-implemented policy on non-O157 E. coli, confirmed positives for O157 and the so-called "Big 6" strains of non-O157 Shiga toxin-producing E. coli (STEC) will be 5 to 10 times higher than currently for O157 alone, Dr. Mohammed Koohmaraie predicted before a recent meat industry conference."

To see entire article: <http://www.foodsafetynews.com/2011/11/under-big-six-ecoli-policy-more-positives-predicts-expert/>

Dr. Mohammed Koohmaraie, with IEH Laboratories & Consulting Group offers

### **E. coli Pathogen Action Thoughts for the Beef Industry:**

1. The animal hide is the principal source of most pathogens.
2. Pathogens get on the carcasses during the hide removal process.

3. How much pathogen is transferred is directly proportional to efficacy of the dressing practices.
4. The function of all interventions after hide removal is to remove pathogens that are transferred from hide onto the carcass during the hide removal.
5. The combined interventions employed by a given plant has the capacity to remove x amount of pathogens. So long as the level of pathogens on incoming cattle is x or lower, the plant has the ability to control pathogens, but if the incoming load exceeds x level, then the plant's intervention systems are not capable controlling the pathogens. Reducing the level of pathogens on the incoming cattle to a level that the plant's intervention can control is essentially the function of pre-harvest interventions. Note that they will have to reduce the level and not eliminate.
6. Lairage (the plant's holding areas and the plant environment, that cattle are exposed to from the time they arrive at the plant) are a major source of hide contamination. In one study we showed 70% of the PFGE (DNA finger print) patterns of cattle hides at the plant (after stunning and bleeding) were different than the one they left the feedlot. This presents a major problem. If I were a feedlot operator and there actually was an efficacious pre-harvest intervention, I will only use only if all the cattle that goes to the plant that will slaughter my cattle have received the same or similar pre-harvest treatment. Otherwise all my efforts will be negated by the contamination from cattle that have not received pre-harvest intervention.
7. The second challenge with pre-harvest intervention is the specificity of the pathogens of concern are multiple and the list is expected to grow. For example vaccination targets a specific organisms. It is reasonable to ask a feedlot operator to use multiple organism specific interventions? That is why I believe we need to challenge the scientific and the pharmaceutical industry to develop one and desirably more broad base intervention that is effective against all enteric pathogens.
8. I have proposed and will continue to propose the most economical and effective approach that I know. We have clearly demonstrated that hide intervention at the plant is very effective, far more than anything we have seen on the pre-harvest interventions. Another advantage is that unlike pre-harvest interventions, there is no chance of recontamination after hide intervention. But the packer should not be expected to bear all the cost. Thus I propose a food safety surcharge on cattle sold to packing plant. In 2011 dollars, the food safety surcharge should be about 2 dollars (cost of running and maintaining the hide wash system).

## **So how can cattlemen take action?**

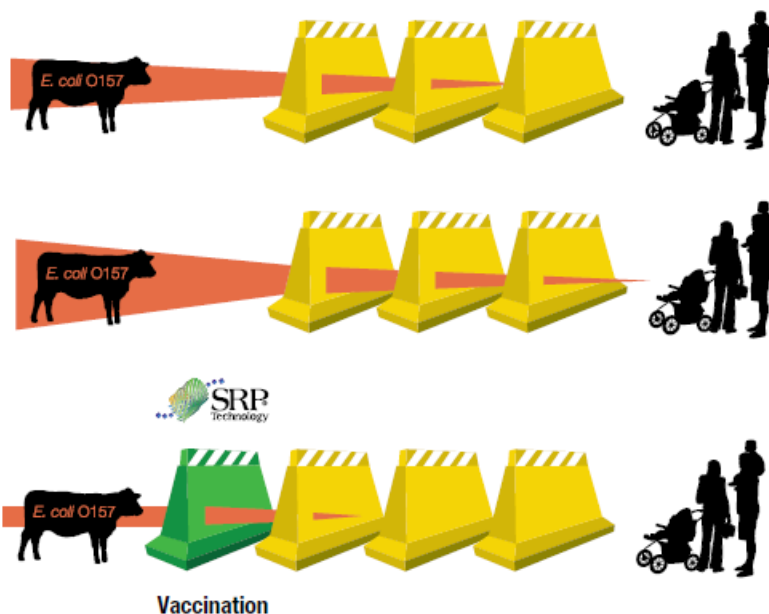
The United States Department of Agriculture Animal and Plant Health Inspection Service Center for Veterinary Biologics issued a Conditional License to Pfizer Animal Health for Escherichia Coli Bacterial Extract vaccine on October 12, 2011. There is compelling evidence that Escherichia Coli Bacterial Extract vaccine will reduce the prevalence and concentration of E. coli in cattle.



This is the first and only vaccine conditionally licensed to reduce the amount of *E. coli* O157 pathogens in the intestines of cattle.

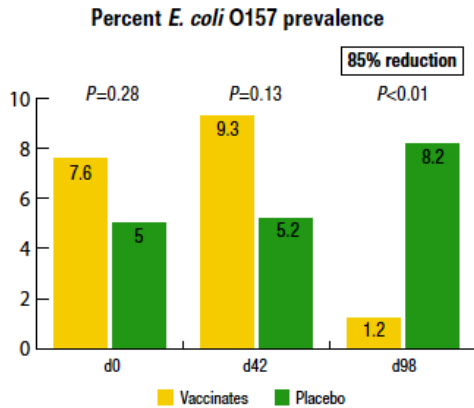
Escherichia Coli Bacterial Extract vaccine is for use in healthy cattle 5 months of age or older to reduce prevalence of the *E. coli* O157 carrier state, and for reduction in the amount of *E. coli* O157 shed in feces to minimize *E. coli* O157 exposure and infection of herd-mates. Administer 2 mL (1 dose) subcutaneously. Revaccinate in two to four weeks and again at least six weeks after the initial dose to complete the initial vaccination program. Efficacy and potency test studies are on-going and in progress. Best results occur when calves are given initial vaccine and booster prior to weaning. Annual vaccinations are recommended after initial vaccination and booster is given.

### Barriers to reduce *E. coli* (Needs caption)

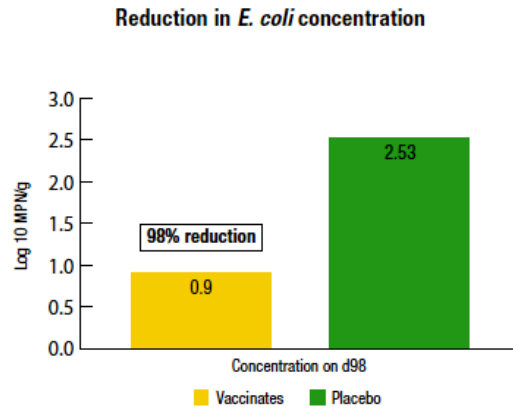


## Effective at reducing *E. coli* O157 in cattle.

A recent field study was conducted in commercial feedlots to quantify the efficacy of the E. Coli Bacterial Extract vaccine with SRP® Technology on reducing the burden of *E. coli* O157 in feedlot cattle.<sup>3</sup>



E. Coli Bacterial Extract vaccine with SRP Technology reduced the number of cattle testing positive for the bacteria by 85 percent.



Those animals still testing positive showed a 98 percent reduction in the concentration of *E. coli* O157.

**\*This product license is conditional. Efficacy and potency test studies are in progress.**

**\*\**Escherichia coli* O157:H7 bacterial strain**

<sup>1</sup> Thomson DU, Loneragan GH, Thornton AB, et al. Use of a siderophore receptor and porin proteins-based vaccine to control the burden of *Escherichia coli* O157:H7 in feedlot cattle. *Foodborne Pathogens and Disease* 2009;6(9):871-877.

<sup>2</sup> Hurd HS, Malladi S. Executive Summary: Outcomes analysis of *E. coli* O157:H7 vaccination in beef cattle. Paper presented at: Food Safety committee of the U.S. Animal Health Association; October 2, 2011; Buffalo, NY.

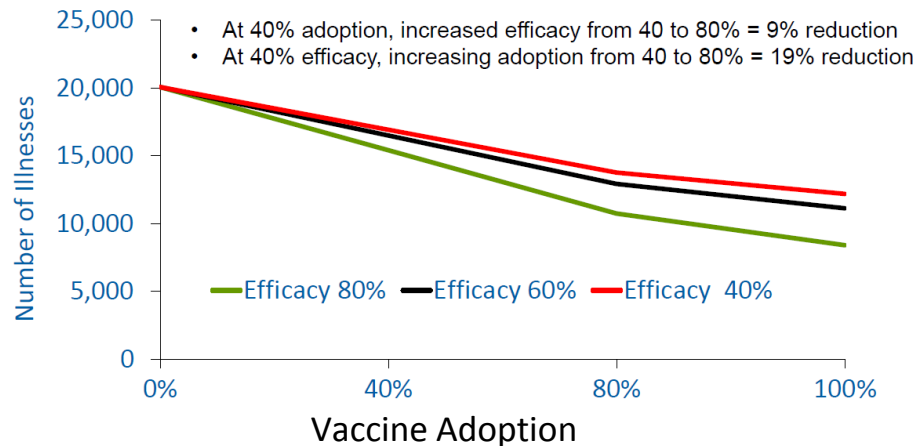
Source: Pfizer Animal Health



# Quantitative Risk Assessment

## Scott Hurd Farm-to-Fork Model

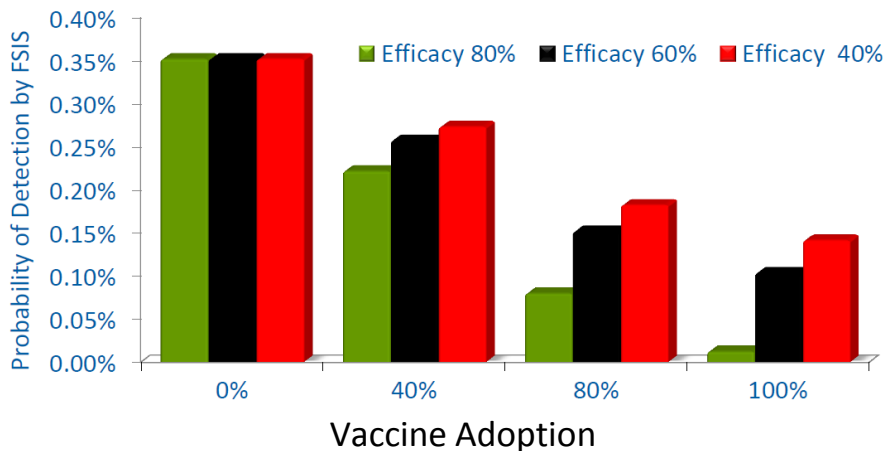
Number of STEC O157:H7 Illnesses Due to Consumption of Ground Beef



# Quantitative Risk Assessment

## Scott Hurd Farm-to-Fork Model

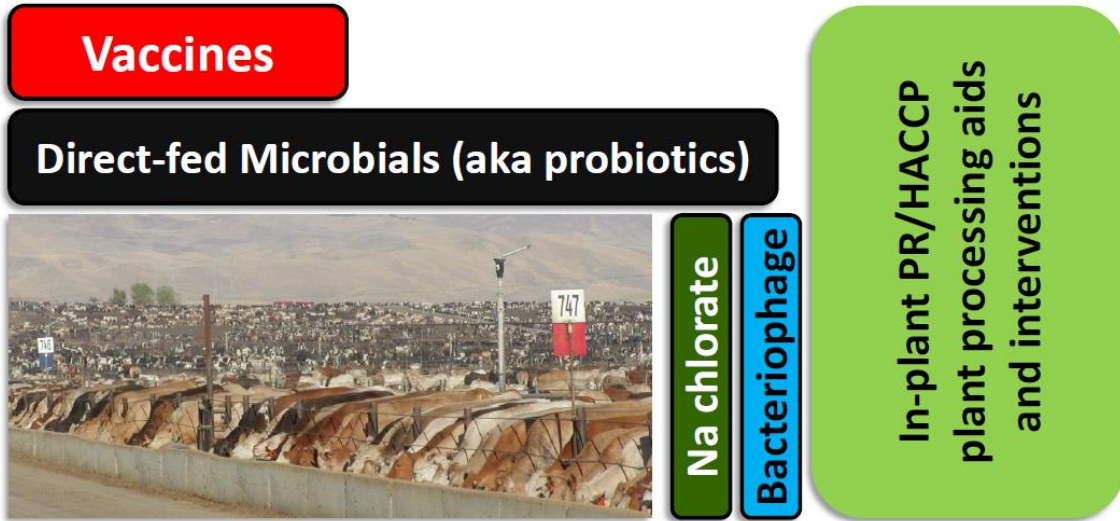
Probability of USDA/FSIS Detecting STEC O157:H7



Source: [http://www.fsis.usda.gov/PDF/Slides\\_Preharvest\\_Loneragan\\_110911.pdf](http://www.fsis.usda.gov/PDF/Slides_Preharvest_Loneragan_110911.pdf)

**Pre-Harvest (Cow/Calf, Stocker, Feedyard) »»»»»»» Slaughter/Fabrication**

All sectors providing maximum effort to reduce E. coli.



Source: [http://www.fsis.usda.gov/PDF/Slides\\_Preharvest\\_Loneragan\\_110911.pdf](http://www.fsis.usda.gov/PDF/Slides_Preharvest_Loneragan_110911.pdf)

**E. coli O157 contamination is costly for all sectors of the beef industry.**

(will replace green chart below with \$ loss data that matches recalls 1994-2011)

- As a result of *E. coli* O157 infection, the Centers for Disease Control and Prevention (CDC) estimates that every year:
  - At least 73,000 Americans are infected **73K Infected**
  - Of those, 2,000 are hospitalized and about 60 die **2K Hospitalized**
- While *E. coli* O157 doesn't make cattle sick, it can profoundly affect consumer confidence in beef
  - \$1.60 Billion** • From 1991 to 1999, beef recalls resulted in approximately \$1.6 billion in lost demand<sup>2</sup>
  - \$2.67 Billion** • Between 1994 and 2004, *E. coli* O157 cost the beef industry an estimated \$2.67 billion<sup>2</sup>
- Fecal shedding of the pathogen also has been linked to contamination of water sources, unpasteurized milk and produce<sup>3</sup>

Now there's a new weapon in the battle against *Escherichia coli* (*E. coli*) O157 that you can use prior to harvest. Escherichia Coli Bacterial Extract vaccine\* with SRP® technology is the first and only vaccine approved by the USDA to reduce the amount of *E. coli* O157 pathogens in the intestines of cattle.

### **Why should I be concerned about E. coli in beef?**

No matter what segment of the beef industry you're in, we're all in this together; fighting a common enemy that threatens the livelihood of each and every person connected with our business. And together, we're committed to doing all we can to help reduce the threat of *E. coli* O157 contamination in beef. Why? Because contaminated beef can lead to sick consumers.

*E. coli* bacteria are members of a large group of bacterial agents that can inhabit the lower intestinal tract of cattle. Most strains are normal inhabitants and do not cause disease in cattle. However, some are pathogenic, or disease causing, when human infections occur, causing serious illness and even death in people. The Centers for Disease Control and Prevention (CDC) estimates that every year at least 63,153 Americans are infected, and of those, 2,138 are hospitalized and about 20 die as a direct result of *E. coli* O157 infection and its complications.<sup>1</sup>

Source: <http://www.cdc.gov/foodborneburden/2011-foodborne-estimates.html>

## **Food Value in Order of Importance**



Beef Quality Assurance Audits are demonstrating significant progress by cow-calf producers, stockers, feedyards, packers and processors since BQA began being implemented in the early 1990s. Currently, cow-calf producers are finally being paid premiums for BQA and value adding vaccination protocols that include vaccines to strengthen calf immune systems against BRD, BVD, BRSV, IBR, PI3, Clostridial/Blackleg and Pasteurella. Many of these combination vaccines benefit (add value to) successive sectors or next owner more than the cow-calf producer. Delivering a consistent, high quality, wholesome and safe product is our Beef Quality Assurance goal!



**Is it time to add the next Beef Quality Assurance food safety level and aim at further reducing *E. coli* pathogens in cattle and safer beef products for our consumers?**

The Beef Marketing Group has 14 feedyards in Kansas and Nebraska participating with *Escherichia Coli Bacterial Extract* vaccine: <http://beefmarketinggroup.com/>

The **BMG** VISION:  


## *Beef Programs & Beef Supply-Chain Management*



*Beef Marketing Group is a beef producer cooperative focused on adding value all along the chain by creating a consistent, sustainable supply of wholesome and safe beef. BMG brings ranchers, packers, retailers, restaurants and food-service suppliers together to create complete beef supply-chain management for branded, conventional, natural and verified beef programs consumers can trust. [Learn more.](#)*



John Butler, General Manager of the Beef Marketing Group shares an update to their Progressive Beef Program:

The Beef Marketing Group is a cattle marketing cooperative, consisting of 14 feed yards located in Kansas and Nebraska. The Beef Marketing Group is very committed to a systems approach to pre-harvest Food Safety. The Beef Marketing Group created and implemented a system of 25 standard operating procedures which is called Progressive Beef. These procedures focus around three pillars of focus. These pillars of focus include Food Safety, Animal Care and Beef Sustainability.

In the area of food safety, Progressive Beef includes a HACCP based system in all feeding operations. In addition, the use of the SRP vaccine is currently optional as an Standard Operating Procedure. If the processor and or end-user of the cattle are going to willing to pay for the vaccine, it will be utilized and backed up by the written SOP.

Progressive Beef is the industry leading pre-harvest system of best management practices with particular focus on Animal Care, Food Safety, and sustainability.



**There is no Silver Bullet for completely eliminating E. coli from beef. So, each sector needs to be engaged in minimizing E. coli to keep contamination events as few as possible. Stay tuned in for more positive Beef Quality Assurance results!**

Additional information sources:

Current FSIS Recalls:

[http://www.fsis.usda.gov/FSIS\\_Recalls/Open\\_Federal\\_Cases/index.asp?src\\_location=Content&src\\_page=FSISRecalls](http://www.fsis.usda.gov/FSIS_Recalls/Open_Federal_Cases/index.asp?src_location=Content&src_page=FSISRecalls)

FSIS Recall Case Archive:

[http://www.fsis.usda.gov/FSIS\\_Recalls/Recall\\_Case\\_Archive/index.asp](http://www.fsis.usda.gov/FSIS_Recalls/Recall_Case_Archive/index.asp)

*E. coli* Outbreak Investigations <http://www.cdc.gov/ecoli/outbreaks.html>