

Feedlot Costs of Vaccinating Cattle for *E. coli*

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Background

Escherichia coli O157:H7 (*E. coli*) is one of the most important food safety concerns facing the beef industry. *E. coli* presence contributes to food product recalls, human health risks, and ultimately reduced consumer demand for beef. As such, reducing prevalence of meat contamination is of utmost importance to the beef industry. Beef food safety is influenced at numerous phases of the production and processing value chain, as such intervention strategies to reduce *E. coli* prevalence need to be considered and evaluated at each production phase. The purpose of this fact sheet is to provide estimates of the costs associated with vaccination programs to reduce *E. coli* presence in the cattle feeding sector. Reducing pre-harvest prevalence of *E. coli* may translate into reducing risk of meat contamination post-harvest.

Costs associated with administering an *E. coli* vaccination program could be as simple as costs of the vaccine plus any labor needed to administer the vaccine if vaccinating does not impact animal feeding performance. However, if feeding performance is impacted, then estimating costs of vaccinating becomes more complex. This fact sheet provides estimates of vaccinating under alternative feedlot cattle handling assumptions and animal performance impacts of vaccinating. Results reveal that these issues make substantial differences in the anticipated cost of administering an *E. coli* vaccination program to feedlot cattle.

Approach

This fact sheet compares net returns to a cattle feeder of administering an *E. coli* vaccination program under various assumptions regarding current feedlot animal management practices and vaccination activity impacts. Costs of vaccination include direct costs associated with the vaccine and the vaccination protocol as well as potential costs associated with animal performance impacts due to the vaccination activity. Stylized cattle feeding budgets are developed with cost assumptions associated with *E. coli* vaccination parameterized based on available published data on impacts of such vaccination programs.

Three net return scenarios are compared. *Scenario 1* is a baseline of cattle feeding net return for a pen of 150 steers that are not vaccinated for *E. coli*. This pen serves as a benchmark for which to compare net returns across alternative vaccination programs. *Scenario 2* assumes the feedlot administers an *E. coli* vaccination program that entails two vaccinations – one administered upon arrival on feed at the same time other normal animal processing activities occur and a second at least 60 days prior to harvest. This scenario assumes the cattle would not have been otherwise run through a chute and handled the second time were it not for the *E. coli* vaccination. *Scenario 2* also assumes no impact of the vaccine or the second chute handling on animal feeding performance. *Scenario 3* is the same as the second scenario only the second vaccination activity is assumed to impact animal feeding performance based on recent research findings discussed below. Together these three scenarios enable comparison across these and other related vaccination cost and impact assumptions.

Budget Assumptions

Table 1 provides assumed inputs into the feedlot budgets for each scenario. The base budget assumes a pen of steers placed on feed at 832 pounds. Non-vaccinated cattle (*Scenario 1*) and vaccinated cattle with no animal feeding performance impact from vaccinating (*Scenario 2*) are assumed to be on feed for 112 days with an average daily gain of 3.29 pounds per head per day and have a finished weight of 1200 pounds. Vaccinated cattle with a cattle feeding performance impact associated with the second vaccination (*Scenario 3*) are assumed to be on feed for 115 days with an average daily gain of 3.20 pounds per head per day and a finish weight of 1200 pounds. Feed conversion (dry matter basis pounds fed per pound of gain) for non-vaccinated and vaccinated cattle with no performance difference is 6.01. Feed conversion for *E. coli* vaccinated cattle with a performance difference is 6.14. Assumed feed conversion and daily gain differences between *Scenario 3* and the other two scenarios are based upon recent research which ranges from finding no difference in animal performance [1] to finding statistically reduced animal feeding performance when a second vaccination was employed [2]. As such, *Scenarios 2* and *3* illustrate differences in net returns associated with no feeding performance change and a reduction in feeding performance associated with the vaccination activity.

A purchase price of \$146.26/cwt was used for all groups of feeder steers when placed in the feed lot. A sale price of \$128/cwt was used for all groups of steers. Death loss is assumed to

be 1% of gross revenue [3]. The following costs are held the same for all scenarios: marketing costs; utilities, fuel, and oil; facility and equipment repairs; interest on facilities and equipment; insurance and taxes; total depreciation; and interest rate on operating costs and purchased cattle. Costs of veterinary, drugs, and supplies (other than the *E. coli* vaccination) are also the same for both scenarios. A first chute charge for processing all cattle upon arrival to the feedlot is incorporated into veterinary, drugs, and supplies cost.

E. coli vaccinated cattle (*Scenarios 2 and 3*) have the following additional expenses that non-vaccinated cattle do not. Vaccinated cattle incur a second chute charge of \$1.50 per head, chute labor of \$0.43 per head, and a first and second *E. coli* vaccine cost of \$2.25 per head. The second chute labor is calculated using the labor rate per hour (\$17) multiplied by an assumed 90 seconds per animal to work cattle divided by 3600 seconds in an hour ($17 \times 90 / 3600$) = \$0.43.

With cattle that are vaccinated for *E. coli* but do not show a feeding performance difference, added charges incurred relative to cattle that are not vaccinated are two *E. coli* vaccines of \$2.25 each and a second chute charge and second chute labor charge. That is, we assume non-vaccinated cattle (*Scenario 1*) are processed through a chute only once. If cattle are normally processed through a chute twice anyway during normal finishing management schemes at a feed lot, then the additional chute charge of \$1.50 per head charged in *Scenario 2* for vaccination could be zero for such a feedlot.

Table 1. Assumed Inputs for Budgets Comparing Alternative *E. coli* Vaccination Scenarios

Assumptions	Scenario 1	Scenario 2	Scenario 3
	Non-Vaccinated	Vaccinate No Performance Difference	Vaccinate Performance Difference
Head per pen	150	150	150
Days on Feed	112	112	115
Average Daily Gain (lbs/head/day)	3.29	3.29	3.20
Feed Conversion (Dry Basis) (lbs fed/lb gain)	6.01	6.01	6.14
Feed Conversion (Wet Basis/As Fed) (lbs fed/lb gain)	13.01	13.01	13.29
Purchase Weight (lbs)	832	832	832
Purchase Price (\$/cwt)	146.26	146.26	146.26
Sale Weight (lbs)	1200	1200	1200
Sale Price (\$/cwt)	128.00	128.00	128.00
Labor Rate (\$/hour)	17.00	17.00	17.00
Death Loss (%)	1.00%	1.00%	1.00%
Veterinary, Drugs, & Supplies (\$/head)	12.00	12.00	12.00
2nd Chute Charge (\$/head)	-	1.50	1.50
2nd Chute Labor Charge (\$/head)	-	0.43	0.43
1st <i>E. coli</i> Vaccine (\$/head)	-	2.25	2.25
2nd <i>E. coli</i> Vaccine (\$/head)	-	2.25	2.25
Marketing Costs (\$/head)	6.00	6.00	6.00
Utilities, Fuel, & Oil (\$/head)	6.00	6.00	6.00
Facility & Equipment Repairs (\$/head)	6.50	6.50	6.50
Interest on Facilities & Equipment (\$/head)	3.25	3.25	3.25
Insurance and Taxes (\$/head)	2.00	2.00	2.00
Total Depreciation (\$/head)	4.50	4.50	4.50
Interest Rate on Operating Costs & Purchased Cattle (%)	5.0%	5.0%	5.0%

Feed Ration Assumptions

The ration used in these budgets is the same ration as used in a recent field research study [2]. Non-vaccinated cattle (*Scenario 1*) and the cattle vaccinated with no performance loss (*Scenario 2*) are fed a total of 4,787 dry matter pounds of feed and vaccinated cattle with a performance loss (*Scenario 3*) are fed 4,891 pounds over the feeding periods (Table 2). Pounds of feed fed are calculated as feed conversion (as-fed basis) multiplied by total gain (ending weight minus beginning weight). The ration on an as-fed wet basis consists of high moisture corn, wet distiller's grain, corn gluten, silage, steep, and micro/minerals mix.

Table 2. Assumed Rations Used in Alternative Budgets

Ingredient	Percentage	Price	Scenarios 1 & 2	Scenario 3
			4,787 lbs.	4,891 lbs.
High Moisture Corn	30.12%	\$ 6.00 /bu	1,441.90 lbs.	1,473.09 lbs.
Wet Distiller's Grain	39.71%	\$ 72.15 /ton	1,900.99 lbs.	1,942.11 lbs.
Corn Gluten	19.05%	\$ 63.34 /ton	911.96 lbs.	931.69 lbs.
Silage	7.76%	\$ 48.00 /ton	371.49 lbs.	379.52 lbs.
Steep	2.44%	\$ 177.90 /ton	116.81 lbs.	119.33 lbs.
Micro/Minerals Mix	0.92%	\$ 322.80 /ton	44.04 lbs.	44.99 lbs.

Net Return

Returns for all groups of cattle are calculated using a purchase price of \$146.26/cwt for feeder cattle and a sale price of \$128.00/cwt for harvested fed cattle. All scenarios have an assumed finished animal weight of 1200 pounds. Total revenue is \$1,536 per head for each. The purchase cost for the steers was \$1,216.88 per head, and the death loss cost was \$15.36 per head (1% of sales). Gross margin after subtracting purchase price and death loss for the pen is \$45,563.52 or \$303.76 per head – the same across all three scenarios (Table 3).

Cattle that were vaccinated and experience a performance loss (*Scenario 3*) have a higher per head feed cost for all feed ingredients than *Scenario 1* or *2* that were not vaccinated or were vaccinated but did not incur a performance loss. The reason for this difference is that the vaccinated cattle with a performance loss have a higher (worse) feed conversion than cattle not vaccinated or vaccinated but with no performance loss. Since cattle that experienced a performance loss have a higher feed conversion, they have to be fed more to have similar gains relative to those without performance losses.

Additional cost differences across the three scenarios are those related to the *E. coli* vaccination. Cattle that were not vaccinated (*Scenario 1*) do not have any second chute costs. Vaccinated cattle (*Scenarios 2* and *3*) have a second chute charge of \$1.50 per head and a second chute labor charge of \$0.43 per head. The *E. coli* vaccine costs \$2.25 per head and the cattle are administered two doses consistent with recent field study research [2]. The only other cost difference is a marginal difference in interest cost between the three groups, with the vaccinated cattle's interest cost being higher.

The reduction in net return for vaccinated steers with a performance loss (*Scenario 3*) is about \$13 per head relative to non-vaccinated cattle. Net return for vaccinated cattle that do not realize a performance loss is about \$6.50 per head lower than non-vaccinated cattle. The reduced

return for vaccinated cattle relative the base is mostly attributable to the cost of the vaccinations (\$4.50) and the cost associated with running cattle through the chute a second time (\$1.93).

Table 3. Net Returns of Alternative *E. coli* Vaccination Scenarios

REVENUE	Scenario 1		Scenario 2		Scenario 3	
	Total	Per Head	Total	Per Head	Total	Per Head
Pounds	180,000	1200	180,000	1200	180,000	1200
Total Revenue	\$230,400.00	\$ 1,536.00	\$ 230,400.00	\$ 1,536.00	\$230,400.00	\$ 1,536.00
Less Purchase Price	\$182,532.48	\$ 1,216.88	\$ 182,532.48	\$ 1,216.88	\$182,532.48	\$ 1,216.88
Less Death Loss	\$ 2,304.00	\$ 15.36	\$ 2,304.00	\$ 15.36	\$ 2,304.00	\$ 15.36
Number of Animals Lost (head)	2.00		2.00		2.00	
Gross Margin	\$ 45,563.52	\$ 303.76	\$ 45,563.52	\$ 303.76	\$ 45,563.52	\$ 303.76
COSTS	Total	Per Head	Total	Per Head	Total	Per Head
High Moisture Corn	\$ 23,173.40	\$ 154.49	\$ 23,173.40	\$ 154.49	\$ 23,674.66	\$ 157.83
Wet Distiller's Grain	\$ 10,287.12	\$ 68.58	\$ 10,287.12	\$ 68.58	\$ 10,509.63	\$ 70.06
Corn Gluten	\$ 4,331.99	\$ 28.88	\$ 4,331.99	\$ 28.88	\$ 4,425.69	\$ 29.50
Silage	\$ 1,337.35	\$ 8.92	\$ 1,337.35	\$ 8.92	\$ 1,366.28	\$ 9.11
Steep	\$ 1,558.50	\$ 10.39	\$ 1,558.50	\$ 10.39	\$ 1,592.21	\$ 10.61
Micro/Minerals Mix	\$ 1,066.26	\$ 7.11	\$ 1,066.26	\$ 7.11	\$ 1,089.32	\$ 7.26
Labor	\$ 2,550.00	\$ 17.00	\$ 2,550.00	\$ 17.00	\$ 2,550.00	\$ 17.00
Veterinary, Drugs, & Supplies	\$ 1,800.00	\$ 12.00	\$ 1,800.00	\$ 12.00	\$ 1,800.00	\$ 12.00
2nd Chute Charge	\$ -	\$ -	\$ 225.00	\$ 1.50	\$ 225.00	\$ 1.50
2nd Chute Labor Charge	\$ -	\$ -	\$ 63.75	\$ 0.43	\$ 63.75	\$ 0.43
1st <i>E. coli</i> Vaccination	\$ -	\$ -	\$ 337.50	\$ 2.25	\$ 337.50	\$ 2.25
2nd <i>E. coli</i> Vaccination	\$ -	\$ -	\$ 337.50	\$ 2.25	\$ 337.50	\$ 2.25
Marketing Costs	\$ 900.00	\$ 6.00	\$ 900.00	\$ 6.00	\$ 900.00	\$ 6.00
Utilities, Fuel, & Oil	\$ 900.00	\$ 6.00	\$ 900.00	\$ 6.00	\$ 900.00	\$ 6.00
Facility and Equipment Repairs	\$ 975.00	\$ 6.50	\$ 975.00	\$ 6.50	\$ 975.00	\$ 6.50
Depreciation on Facilities & Equipment	\$ 675.00	\$ 4.50	\$ 675.00	\$ 4.50	\$ 675.00	\$ 4.50
Interest on Facilities & Equipment	\$ 487.50	\$ 3.25	\$ 487.50	\$ 3.25	\$ 487.50	\$ 3.25
Insurance & Taxes on Facilities & Equipment	\$ 300.00	\$ 2.00	\$ 300.00	\$ 2.00	\$ 300.00	\$ 2.00
Interest	\$ 3,170.86	\$ 21.14	\$ 3,178.26	\$ 21.19	\$ 3,270.50	\$ 21.80
Total Costs	\$ 53,512.98	\$ 356.75	\$ 54,484.12	\$ 363.23	\$ 55,479.54	\$ 369.86
NET RETURN	\$ (7,949.46)	\$ (53.00)	\$ (8,920.60)	\$ (59.47)	\$ (9,916.02)	\$ (66.11)

Net Return Sensitivity to Sell Price at Different Corn Prices

Net return impacts were also calculated for each scenario under alternative corn price assumptions of \$4.00/bushel, \$6.00/bushel (base assumed in budgets presented above – see Table 2), and \$8/bushel to illustrate how feed cost differences impact costs associated with *E. coli* vaccination. To complete this sensitivity analysis we held the fed cattle sale price constant and adjusted feeder cattle purchase price as corn price varied to keep net return for vaccinated cattle approximately constant across the three different corn prices. We also let other feed ingredient prices vary as in accordance with the corn price. In this way, we could isolate how the net return to vaccinated cattle changed relative to non-vaccinated with changing feed prices.

As corn price increases, the net return differences between *Scenarios 1* and *2* and *Scenario 3* widen. That is, given the reduction in feeding performance associated with cattle in

Scenario 3 compared to *Scenario 1* and 2, higher feed prices result in greater feed cost for *Scenario 3* compared to the others. At \$4.00/bushel corn, *Scenario 3* has a net return that is about an \$11 per head lower than *Scenario 1*, at \$6.00/bushel the difference increases to \$13 per head, and at \$8.00/bushel corn the difference is \$15 per head. Because *Scenario 2* has the same feed efficiency as *Scenario 1*, changes in feed cost affects the two scenarios by the same amount keeping *Scenario 2* at about a \$6.50 per head lower net return.

Concluding Observations

If a feedlot is already sending cattle through a chute two times during their normal cattle management plans that coincide with the *E. coli* vaccination program label requirements including a 60-day withdrawal, then added costs associated with vaccinating would be the vaccine plus labor needed to administer the shot. Combined, these costs would likely be less than \$5 per head. However, if a feedlot is sending cattle through a chute only one time, then an additional chute charge and labor would be necessary with the vaccination plan assumed here and the overall *E. coli* vaccination cost without an animal performance loss would be around \$6.50 per head and with a performance loss around \$13 per head plus or minus, depending on feed price. Whether an *E. coli* vaccination program causes performance losses is obviously an important consideration that needs additional research to resolve.

Works Cited

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