

***E. coli* O157 Risk Reduction: Economic Benefit to Canada**

The following information is excerpted from a 2009 study by the George Morris Centre in Guelph, Ontario.

This paper serves as an update and elaboration of the 2007 George Morris Centre report entitled “The Economic Benefit of a National *E. coli* Source Control Program.” The purpose of this project is to determine the economic benefits of an *E. coli* O157 control program involving immunization of cattle.

In addition to that fundamental purpose, this paper seeks to present new information and to re-evaluate the previous analysis. This will serve to present industry and governments with the most up to date and relevant assessment of an *Econiche*TM vaccination program.

The impacts or results associated with *Econiche*TM are the reduction or mitigation of negatives. *E. coli* O157 has several negative impacts including sickness, death, industry costs and lost demand. *Econiche*TM reduces *E. coli* O157 from the cattle herd. The reduction or elimination of these negatives are the benefits of *Econiche*TM. These benefits will be measured against the costs in a benefit/cost ratio.

Cost of Illness

The cost of illness (COI) method estimates the costs incurred through the incidence of an illness in a population. The total cost of illness is calculated by taking the sum of the total:

- 1) medical costs
- 2) loss of productivity
- 3) loss of life

The cost of illness for all Canadian *E. coli* O157 infections was calculated in a previous George Morris Center report, based on US data. The current report attempts to include as much Canadian data as possible. The changes in this report pertain to an adjustment for the cases of *E. coli* O157 infection complications per age group, including the use of value of life as recommended by the Treasury Board of Canada, an update of health care costs to 2008 and inclusion of an under-reporting factor based on Canadian population surveys. The approach taken to calculate the complications of *E. coli* O157 infections in this report follows the cost of illness calculation methods and assumptions used by Ruzante et al. (2009), which was based on methods used by Henson (2005), Havelaar et al. (2007) and the USDA/Economic Research Service’s (ERS) Food-borne Illness Calculator.

Attribution

According to the Public Health Agency of Canada (PHAC) food attribution database, ground beef is the primary vehicle for 40% of all food-borne *E. coli* O157:H7 cases (Judy Craig, PHAC, personal communication). The CDC data shows that 33% of food-borne cases are attributed to ground beef and 11% to other beef consumption. Hence, according to the CDC outbreak data, 44% of food-borne *E. coli* O157 cases are attributed to all beef consumption. This number has been adopted for the purpose of this report. Imports account for about 20% of Canadian beef consumption. Conversely, 80% of Canadian beef consumed is produced here. Scientific investigations have not demonstrated a difference in the prevalence of *E. coli* O157 between Canada and other countries. Therefore, we will assume equal levels of contamination. It then follows that 80% of the VTEC infections from beef consumption would be associated with domestic production.

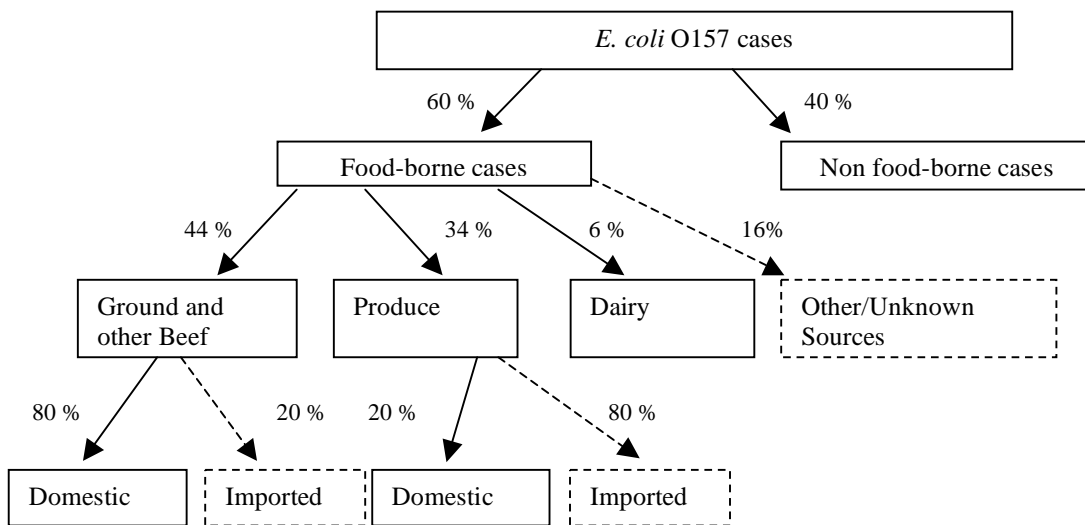
According to the CDC data, 34% of food-borne *E. coli* O157 cases can be attributed to produce. The majority of Canadian produce is imported. According to Statistics Canada data, more than 80% of lettuce, 90% of spinach and 75% of broccoli and cauliflower is imported. It is therefore assumed that

80% of all produce is imported. Sixteen percent of food-borne *E. coli* O157 illnesses are attributed to ‘other sources’ and unknown sources. These sources of illness are excluded from the calculation.

Not all reported Verotoxigenic *E. coli* (VTEC) infections are food-borne. Forty percent of VTEC infections are of non-food-borne origin and are associated with drinking water, recreational water, person-to-person and animal contact. It is highly likely that almost all of the non-food-borne incidences are from domestic sources. It is assumed that domestic sources will be from cattle.

Figure 1 provides an overview of the attribution assumptions. Percentages included in the calculation are shown by solid boxes. Excluded are imported beef and produce and unknown food-borne sources. Based on these assumptions, we assume that 69% of the Canadian VTEC infection cases can be attributed to domestic cattle production and consumption of beef.

Figure 1: Food and Non-Food Source Attribution Assumptions



Cost assumptions

The medial cases have been divided into mild, moderate and severe cases of illness (Ruzante et al. 2009). Mild cases do not result in a visit to a physician and are treated with over the counter medication. Moderate cases require doctor consultations. Severe cases require hospitalization or result in death. The cost calculation follows the 2007 George Morris Centre report, where numbers have been adjusted to 2008 dollars.

The cost of a visit to a physician was taken from the National Grouping System Categories Report, Canada, 2003-2004 (Canadian Institute for Health Information (CIHI), 2006). Data have not been updated since 2006. This report uses the National Physician Database to report statistics on the utilization, cost and distribution of physicians’ services through provincial medical care insurance plans. The report gives a detailed breakdown of cost per service for various types of physicians. For the purpose of this research, the reported cost per service of a family medicine physician was used and adjusted to 2008 value using the Consumer Price Index (CPI) for health care. The cost was calculated to be \$62.17 per visit.

Reported ambulatory care visits and expenditure by hospitals, in the functional centers of ambulatory care and emergency within the hospital, were used to calculate the average cost of an emergency department visit. The reported data from CIHI was for 2002-2003. Therefore, the calculated cost was converted to 2008 value using the CPI for health care, giving a cost per visit of \$116.15.

The cost of hospitalization was again calculated using CIHI data. To estimate the cost per day, the total number of inpatient days was divided by the total hospital expenses reported in 2002-2003 (CIHI,

2005). This was then adjusted to 2008 value using the CPI for health care, culminating in a daily cost of \$1,171.24. The cost of hospitalization for someone with HUS would be higher largely due to haemodialysis and the intensive care required for a patient with kidney failure. An estimate for this type of treatment in Canada was not found. Therefore, an adjusted estimate was established using the US data (USDA, 2006). World Health Organization statistics show that in 2005, per capita expenditure on health care in Canada was 52% of the per capita expenditure in the United States (World Health Organization, 2006). Using this ratio, a patient admitted to a Canadian hospital with HUS is estimated to cost \$22,181 per admittance.

It is assumed that patients who do not visit a doctor will treat themselves with over the counter medications. The cost of outpatient medication was difficult to establish in this context, especially to narrow the cost down to those medications used in the treatment of an *E. coli* O157 infection. Research on the difference in drug prices between Canada and the United States reported an average discount in Canada of 24% at the retail level (Graham and Robson, 2000). Therefore, to estimate the costs of both prescription and non-prescription drugs in Canada this report used the costs given by Frenzen et al (2005), adjusting them to a 2008 Canadian dollar value and discounting them by 24%. The cost for the drugs used in the treatment of an *E. coli* O157 infection was calculated as \$8.60 for non-prescription drugs. Taking these costs into account, Table 4.6 shows a summary of these calculations.

Table 4.6: Medical costs

Year	Mild	Moderate	Severe w/o HUS	HUS (non ESRD)	ESRD	TOTAL
2004	\$42,519	\$138,976	\$3,454,684	\$2,050,393	\$407,778	\$6,094,350
2003	\$41,987	\$137,237	\$3,411,465	\$2,106,170	\$418,871	\$6,115,730
2002	\$49,168	\$160,709	\$3,994,928	\$2,576,480	\$512,405	\$7,293,691
2001	\$52,801	\$172,583	\$4,290,105	\$2,938,916	\$584,486	\$8,038,891
AVG	\$46,619	\$152,376	\$3,787,796	\$2,417,990	\$480,885	\$6,885,665

The total medical costs of an average annual incidence rate from 2004-2001 results in \$6.8 million in 2008 dollars.

Loss of Productivity

The loss of productivity calculation was based on the assumption that 54% of the population is in active employment with an hourly wage of \$18.68 (Statistics Canada, 2009) and an average weekly work load of 33.5 hours (Henson, 2005).

The total loss in productivity amounts to \$829,966 in 2008 dollars.

Loss of Life

The implementation of the vaccination is expected to reduce the risk of infection and, therefore, the risk of premature death. Benefits of these risk reductions are generally measured in terms of the Value of Statistical Lives (VSL). This measure is derived from the aggregation of many small risks over an exposed population (Treasury Board of Canada, 2007). The Treasury Board of Canada (2007) recommends the use of a VSL of \$6.11 million CAD (2004 value) and an adjustment for inflation, using the Canadian CPI. Hence, the VSL was adjusted to \$6,668,628.

Using the average incidence values from 2001 – 2004 and the above mentioned assumptions, on average 2 lives were lost due to *E. coli* O157, resulting in a VSL loss of \$13,739,906.

Based on the average incidence rates from 2001 to 2004 and the assumption that 69% of Canadian *E. coli* O157 cases are caused by domestic sources, the total cost of illness is estimated to be **\$21,544,796** in 2008 dollars.

***E. coli* Recalls and Industry Costs**

Volume of Recalls

From the beginning of 2004 through the first quarter of 2009, there were approximately 640 recall notices issued by the CFIA. The majority were voluntary recalls conducted by the manufacturer, retailer or importer and were classified as either a Health Hazard or an Allergy Alert. Allergy Alerts typically involve peanuts or some other previously unidentified allergen in the product. Health Hazards usually involved a bacterial entity found in the food such as *salmonella*. Allergy Alerts and Health Hazards were roughly evenly divided as the causes of the recalls.

E. coli recalls are included in the Health Hazard classification. Of the total recalls, *E. coli*-related causes were fewer than 30 of the 640 events representing about 5% of the total. Over the five years from 2004 through 2008 there was no pattern to the total number of recalls. Unlike human illnesses, there was also no noticeable seasonality pattern in the recalls. Recalls averaged about 5 per year. There was a large volume of recall activity in late 2007 associated with the one event at Ranchers Beef in Alberta. Contaminated beef was the cause of nearly all the *E. coli* recalls, with only three involving produce.

Packer E. coli Recall Costs

Based on examination of the recall cases on the CFIA website, each recall, on average, amounts to less than 4 tonnes. In fact, the retail recalls are in the range of less than 1 tonne. Even if ten tonnes per recall is used as a base, and if it is assumed that there are five recalls per year, at \$3.30/kilogram, the total value of product recalled and destroyed would, in most cases, be less than \$200,000 per year. This likely overestimates the destroyed amount – most products are not returned in a recall (particularly fresh ground beef and other fresh perishable products).

With regard to the labour involved, there is no doubt that the process can be very labour intensive. It can involve administrative and production salaried and hourly employees. The labour-related costs would involve overtime as well as lost productivity. Tabulation of lost time and wages per year would likely place industry losses at around \$200,000-500,000.

When all is considered, the total costs to the industry are not materially significant given that total revenues average around \$4.5 billion at the packer level. At an upper level, recalls might cost the industry, from packer through retail, approximately \$1 million per year in direct costs.

Firms Driven from Business

While the annual recall costs might not be material to the overall industry, the costs of an *E. coli*-related event to an individual company can significantly damage that company's reputation and brand. If a packer experiences two recalls in a year, its marketing and sales opportunities and pricing leverage are severely curtailed. *E. coli* O157-related recalls have driven companies out of business. For example the following events were widely reported in industry trade reports and in the mass media:

1. In the U.S. in 1997, Burger King terminated a contract with Hudson Meats, forcing that company to exit the industry, after it underwent a huge recall of its meat products due to *E. coli* O157:H7 contamination.
2. In 2007, a massive *E. coli*-related recall by US-based Topps Company forced it to file for bankruptcy protection. Some of the beef from Topps was shipped from Ranchers Beef in Alberta.
3. U.S. spinach producers experienced a complete loss of sales when the Food and Drug Administration advised consumers to stop eating fresh and bagged spinach in the wake of an outbreak in fall 2006 due to *E. coli* contamination.

It should be noted that this discussion of industry costs has not included the entire area of product liability. Liability associated with recalls or related illnesses can amount to tens of millions of dollars. These costs will not be included in the overall tabulation of *E. coli* costs given that they cannot be estimated with any certainty. Nevertheless, they form an important component of risk and cost for the beef industry.

Demand

This section of the report attempts to assess the impact of *E. coli* O157 on beef demand. The purpose of the section is to quantify the financial impact of consumer concerns regarding *E. coli* O157 as it relates to reduced consumption and expenditures. The fundamental premise is to determine how damaging *E. coli* O157 has been to the beef industry in terms of consumer expenditure. The main source of information and analysis is previous academic and industry research into factors that drive beef demand.

Defining Demand

Demand is the quantity of product consumed at various price levels. It is generally expected that as prices increase, the quantity consumed will decrease and vice versa. What is particularly interesting is when quantity consumed increases (or decreases) while prices increase (or decrease). Cases where quantities decrease with decreasing prices or increase with increasing prices are known as decreasing demand or increasing demand respectively. Factors that cause demand to increase or decrease are of great interest and concern to any industry.

Kansas State University (KSU) researchers conducted one benchmark study that assessed individual factors that influence beef demand in 2000 (Schroeder et al., 2000). That 2000 study was updated and revised in January 2009 (Schroeder et al., 2009). The original and subsequent analysis showed that demand for beef either increases or decreases based on factors such as the following:

- Changes in prices of competing meats
- Changes in consumer expenditures (income)
- Changing consumer demographics
- Food safety problems
- Health information

With regard to food safety, which is the issue associated with *E. coli*, the researchers used food recall activity as the factor to gauge consumer demand response. USDA Food Safety Inspection Service beef recalls were tabulated from 1982 through 2007. Model results reveal food safety recalls adversely impact consumer demand for beef. The model showed that a 10% increase in beef recalls is associated with a 0.2% decline in beef demand. However, the impact of food safety recalls is most pronounced when recalls increase sharply.

In addition, the USDA's Economic Research Service has asserted that "highly publicized international food safety incidents may lead to lasting changes in consumer perceptions about food safety and their food purchasing patterns. Here, the hypothesis is that, following the resolution of the problem that caused a major international food safety incident, consumer perceptions about the implicated food product and about the exporting country's ability to produce safe food may be slow to change, and these perceptions have a lasting influence on food demand and global trade (USDA, 2001)."

The two key messages of this section, therefore, are as follows:

1. Food safety issues associated with *E. coli* have serious negative consumer demand ramifications for the affected products.
2. These food safety issues could translate into negative implications for Canada's ability to export beef and other products around the world.

Quantification

In order to quantify the demand-related benefit, the starting point is the estimation of beef demand in Canada. According to Canfax, over the past four years, total beef expenditures in Canada have amounted to about \$6.5 billion annually. That expenditure is the current beef demand in Canada.

KSU found that a 10% increase in recalls leads to a 0.2% decrease in beef demand. A 10% reduction in beef recalls would not result in increased beef demand, but it would mean that the expected or likely reduction in demand would be reduced by 0.2%. The benefit for beef demand in Canada of a 10%

reduction in recalls would amount to \$13 million per year ($0.2\% \times 6.5$ billion). If in fact, recalls are reduced by 80% due to the reduction of the pathogen in the Canadian herd and hence Canadian beef, that would have corresponding benefits on beef demand. An 80% reduction in recalls could benefit beef demand by \$104 million ($8 \times \13 million, or $1.6\% \times 6.5$ billion).

It is not possible to make a 100% effective claim for an entire country, even assuming all cattle are vaccinated properly. To be very conservative, if it is assumed that one quarter of Canadian-based *E. coli* cases remain, that would imply that the losses in demand would be reduced \$78 million per year ($\104 million $\times 75\%$). That suggests that demand could benefit by about 1.2% each year ($\$78$ million/ $\$6.5$ billion).

Conclusion

The following is a summary tabulation of the benefits to Canada.

Medical:	\$21million
Recalls and Industry:	\$4 million
Demand:	\$78 million
Total:	\$103 million

About the George Morris Centre

Founded in 1990, the George Morris Centre is a Canada-wide, not-for-profit charitable organization based in Guelph, Ontario. As an independent think-tank, the Centre provides industry decision makers with critical information and analysis on issues affecting the Canadian agri-food sector. The Centre's products and services assist public and private sector clients who are adjusting to change, and those leading the change.

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