Economic Analysis of Johne’s Disease Control Strategies in Dairy Herds

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Economic Analysis of Johnie’s Disease Control Strategies in Dairy Herds

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INTRODUCTION

Johnie’s disease (JD) is a chronic, infectious, incurable intestinal disease of ruminants, caused by the pathogen Mycobacterium avium subsp. paratuberculosis (MAP). The disease affects significant economic loss, $200–$200 million annually in the dairy industry due to a reduction in milk production, lower slaughter value, and suboptimal calf production. Although definitive proof has not been established, MAP has been associated to be a cause of Crohn’s disease in humans. This potential link between JD and CD, coupled with the high cost of JD, increases the need for evaluating the cost-effectiveness of JD control methods.

Johnie’s disease is control difficult because of the absence of an effective treatment or vaccine for the disease. The long incubation period of the disease and the low sensitivity of currently available MAP tests. Given these limitations, the control and possible elimination of the disease can be best done by testing and eliminating infected animals or by the use of control strategies that were modeled to include this test-and-cull with annual and biannual MAP testing, improved calf management, housing, and culling practices. Given ineffectiveness of detection and limited data on its impact or reducing or delaying shedding phenomena it was not included as a control.

The objective of this research was to evaluate the long-term economic feasibility and effectiveness of various JD control methods on the individual farm. An optimal control model for profit-maximizing producers was constructed and solved to derive optimal behavioral responses of producers making economic decisions on controlling the disease. Results for combinations of control strategies are compared to determine the most profitable, least time-consuming, and recommended methods for controlling the disease over a 20 year planning horizon of a dairy farm.

METHODS

Optimal control model was constructed integrating biology of animals and disease into an economic framework. Since the effects of JD control are slow and often are slow to become apparent, as infections take several years to reach clinical status, evaluating the benefits of control programs can be done by constructing a model that emulates the dynamics of MAP transmission within a herd (Figure 1).

RESULTS

The model was modified from Mitchell et al. (2008) and provides for control options including improving hygiene and management, implementing culling, and culling heifers. Figure 1 illustrates the disease transmission dynamics. The model illustrates disease control strategies are evaluated for different scenarios: no control, culling heifers only, culling heifers and reducing the prevalence of infected animals, and culling heifers and reducing the prevalence of infected animals with an additional control strategy for reducing the prevalence of infected animals.

CONCLUSIONS

Results showed that JD control method yields a higher NPV compared to no control. Elimination of JD was shown to be less expensive than implementation of other additional control measures such as culling of infected animals when implemented with other control methods. The results of the study are applicable directly for US dairy farms and would contribute to society if it becomes desirable to eliminate the disease from dairy herds as quality as possible to reduce economic impacts to the dairy industry from the spread of JD across herds, or to prevent the public health risks associated with the potential link between JD and Crohn’s disease in humans.

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