Modeling the risk from potential BSE exposure in a simulated national cattle herd: A methodological contribution.

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Abstract

In 2001 the Harvard Center for Risk Analysis (HRA) evaluated the robustness of U.S. measures to prevent the establishment and spread of BSE to animals and humans. They found that if introduced into the U.S., it would be extremely unlikely to become established and certain to be eliminated from the country within 20 years provided the conditions affecting the spread of BSE in the U.S remain unchanged.

As time passes, the probability of finding previously undetected cases of BSE in the U.S. national cattle herd become increasingly more remote. A methodology for periodically updating the 2001 HRA to reflect this ever-shrinking probability is described.   This methodology utilizes most recent available USDA/APHIS BSE surveillance data to reduce the uncertainty distribution associated with the original Harvard analysis.

Introduction

The Harvard Center for Risk Analysis has evaluated the robustness of U.S. measures to prevent the spread of bovine spongiform encephalopathy (BSE or "mad cow disease") to animals and humans if it were to arise in this country. The Harvard Center for Risk Analysis developed a probabilistic simulation model to help characterize the consequences should BSE enter into the U.S. The Harvard baseline analysis showed that, given current safeguards,

> *the U.S. is highly resistant to any introduction of BSE. If introduced, it is extremely unlikely to become established and certain to be eliminated from the country within 20 years provided the conditions affecting the spread of BSE in the U.S remain unchanged.*

After BSE was found in the UK, the U.S. government implemented a number of measures to prevent BSE from entering the U.S. and to prevent the spread of the disease should it be introduced. These measures include the following:

- 1989: USDA prohibited the importation of live cattle and certain cattle products, including rendered protein products, from countries where BSE was known to exist. In 1997 these importation restrictions were extended to include all of the countries in Europe.
- 1997: FDA (US Food and Drug Administration) prohibited the use of most mammalian protein in the manufacture of animal feeds given to cattle and other ruminants.

- 2000: USDA prohibited all imports of rendered animal protein products, regardless of species, from BSE-restricted countries.

Materials & Methods

The Harvard baseline scenario assumed ten cattle infected with BSE were imported into the Harvard simulated national herd.   This scenario also assumed all current US mitigations to prevent the introduction and spread of BSE were in place at the start of the initiating event.

Our model uses sampling evidence about the absence of BSE in the US to reduce uncertainty about undetected prevalence in a simulated US national herd.   The following 3-step algorithm was used.

(1) An estimated a distribution for the number of animal ID50s that could have entered the US national herd from the UK prior to the European cattle import ban that was imposed in 1989 (Harvard BSE appendix 2 1.1).
(2) An estimate of the potential BSE infectivity imported then serves as an input to the Harvard model to estimate a prior distribution for the number of undetected infected animals that could exist in the simulated national herd in 2002.
(3) Using Bayes theorem, we estimate a posterior distribution for the number of undetected BSE-infected cattle that could exist in the simulated national herd today.   The sampling evidence used in this part of the analysis is the surveillance testing results conducted in 2002 by USDA's Animal and Plant Health Inspection Service (APHIS).

Results

Overall baseline results indicate a high probability, 99.8 percent, that no undetected-infected cattle are present in our simulated national herd today. Those results are designed to serve as the new baseline for future analysis of BSE spread and mitigation within the simulated national cattle herd and beef slaughter/fabrication sectors. Such a simulation is useful in informing preventative measures to the introduction of BSE in the US.
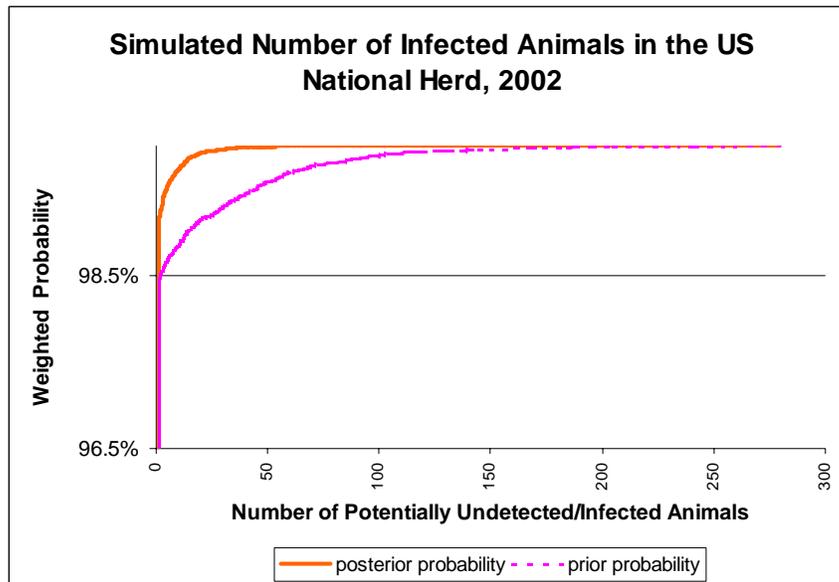
Figure. Effects of Bayesian Update on Predicted Number of Undetected-Infected Cattle in the National Herd in 2002.

Discussion

The analysis shown here supports the general conclusions from the Harvard baseline scenario. However, the Harvard baseline scenario has been misinterpreted to argue that infected cattle introduced into the US prior to the implementation of the 1989 import ban, the 1997 US feed ban, and the 2000 import feed ban would have led to the Harvard baseline result. This has led to disagreement about the applicability of the model. This analysis shows that the Harvard model can be appropriately used to simulate a Bayesian prior on potential BSE infectivity – which can then be updated using available surveillance data.

This approach can apply to countries other than the US – given appropriate parameter modifications. Results of this approach can also serve as input for further runs of the Harvard model into future periods – and thus be used to analyze the effect of additional mitigations being considered to further reduce probability of, for example, BSE exposure through human food.

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Import Ban: http://www.aphis.usda.gov/lpa/issues/bse/risk_assessment/bseposter.pdf

USDA Surveillance: http://www.aphis.usda.gov/lpa/issues/bse/backgrounder.html