

Simulation model of vaccinating cattle against STEC O157 for pre-harvest food safety

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Pens of cattle with high *Escherichia coli* O157:H7 (STEC O157) prevalence at harvest may present greater risk to food safety than pens of lower prevalence. Vaccination against STEC O157 reduces STEC O157 prevalence in live cattle. Our objective was to create a stochastic simulation model (@Risk, V 5.7.1), to compare STEC O157 prevalence distributions for summer- and winter-fed cattle to summer-fed cattle immunized with a 3-dose regimen of Type III secreted protein (TTSP) vaccine. Model inputs were an estimate of vaccine efficacy, observed frequency distributions for number of animals within a pen, and pen-level fecal shedding prevalence for summer and winter. Uncertainty about vaccine efficacy was simulated using a log binomial distribution from a previous performed meta-analysis of four randomized controlled 3-dose regimen TTSP vaccine trials. The outcome was post-vaccination STEC O157 fecal pen prevalence. The simulation was performed 5,000 times. Summer fecal prevalence ranged from 0-80% and averaged 30% (std dev±0.24). Forty-one percent of summer-fed pens had STEC O157 prevalence greater than 30%. Winter fecal prevalence ranged from 0% to 60% and averaged 10% (std dev±0.13). Seven percent of winter-fed pens had STEC O157 prevalence greater than 30%. Fecal prevalence for vaccinated pens of summer-fed cattle ranged from 0-53% and averaged 16% (std dev±0.13). Sixteen percent of vaccinated pens had STEC O157 prevalence greater than 30%. The simulation outcome was most sensitive to shedding prevalence of control pens of cattle. In this simulation vaccination mitigated the risk STEC O157 fecal shedding to levels comparable to winter, with the major effect being reduced variability in shedding prevalence. Food safety decision-makers may find this model helpful for evaluating the usefulness of pre-harvest interventions.