A MODEL APPROACH TO ESTIMATE *STAPHYLOCOCCUS AUREUS* INTRAMAMMARY INFECTION DYNAMICS FOR DIFFERENT SCENARIOS WHEN VACCINATING FOR MASTITIS

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INTRODUCTION

When new remedies or treatments are considered for used in a farming enterprise the main concern is whether the benefit will outweigh the cost and predicted losses. Benefits however should not only be measured in economic terms. In addition to stochastic partial budget models that estimate cost and benefits when using STARTVAC® (HIPRA) mastitis vaccine, a model was developed to calculate the intramammary infection (IMI) dynamics of *Staphylococcus aureus (S. aureus). S. aureus* is a highly contagious and potentially destructive udder pathogen. Its' transmission rate depends on various factors but parlour management and pathogenicity of bacteria are prominent. The number of *S. aureus* IMI within a herd need to be reduced to the point of eradication.

METHOD AND MATERIAL

The model was developed in an attempt to optimize estimations of benefits by determining the numbers of clinical cases likely to occur over a period of time and to analyse persisted cases at end points. The reasoning that subclinical *S. aureus* IMI either advanced to clinical mastitis (19% & 17%), cure spontaneously (3% & 21%) or persist (78% & 62%) was exploited in old and new IMI respectively as it was further anticipated that the percentage of persistence, cure and clinical cases would differ between old and new *S. aureus* IMI. The transmission parameter (β) used in low and high risk scenarios was based on research results and vary from 0.0028 to 0.0460 new infections daily. The duration of a persistent *S. aureus* IMI was taken as 115 days when few interventions took place in a herd. This duration was shown to decrease to 51 days in low somatic cell count herds, when an aggressive approach to detect and to treat subclinical *S. aureus* cases were in place. According to previous research the basic reproduction ratio (Ro) of S. aureus IMI was reduced by approximately 45% with the use of STARTVAC® mastitis vaccine in a herd.

Four different scenarios, all with a *S. aureus* IMI herd prevalence of 15% were explored. The different transmission parameters for *S. aureus* were combined with and without treatment of subclinical *S. aureus* cases. In all four scenarios vaccinated and non-vaccinated herds were compared. The model explored two scenarios in herds with a low transmission probability: {scenario A} without treatment of subclinical cases and an estimated persistent *S. aureus* infection of 115 days and {scenario B} with aggressive treatment and an estimated persistent *S. aureus* infection of 51 days. In addition IMI dynamics were calculated in herds with a high transmission probability: {scenario C} without treatment of subclinical cases and an estimated persistent S. aureus IMI across cows of 115 days and {scenario D} with aggressive treatment and an estimated persistent S. aureus infection of 51 days.

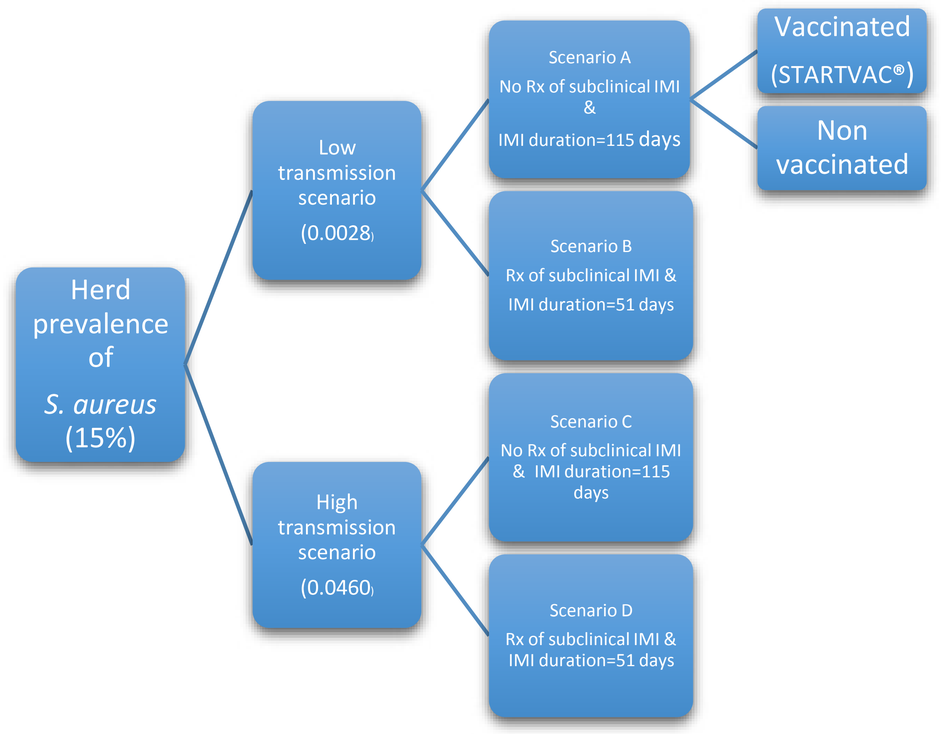

Figure 1. Illustration of the different scenarios explored in the model.

RESULTS

In scenario A it was estimated at day 153, that 3.37clinical cases had occurred and 0.01 *S. aureus* cases persisted in the non-vaccinated group compared to 3.13 clinical cases no persistent cases in the vaccinated group. In a non-vaccinated herd during scenario C after 51 and 204 days the persistent *S. aureus* cases increased from 17.02 to 28.19 and clinical cases from 7.50 to 39.15 compared to a reduction in persistent cases from 9.36 to 1.42 and a smaller rise in clinical cases from 5.4 to 13.04 cases when vaccinated. The differences in persistence and clinical cases between non- and vaccinated groups in Scenario D were estimated at day 255 to be 54.60 and 81.20 compared to 16.52 and 30.96 respectively. Results indicated that the longer this mastitis vaccine was used the more distinct its benefits became. During a low risk scenario when vaccination was used in combination with treatment of subclinical *S. aureus* cases, *S. aureus* IMI was eradicated an estimated 51days earlier than when treatment was used by itself. More pronounced effects were also detected in all high risk scenarios. Persistent *S. aureus* IMI continue to increase in high risk scenarios where subclinical *S. aureus* cases were only treated but decreased under the same conditions when treatment was combined with vaccination.

CONCLUSIONS

The model revealed that the use of this mastitis vaccine provided additional benefits to combat *S. aureus* IMI in both high and low transmission risk scenarios. Less clinical cases occurred from the first time cycles but the advantages intensified with duration of use. The only high transmission risk scenario, where persistent and clinical cases were reduced over time was when treatment of subclinical cases was used in combination with the mastitis vaccination. Models such as this have practical applications and can assist both veterinarians and producers in optimizing predicted cost, benefits and can including the IMI dynamics of *S. aureus* into in their future planning.

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