Protocol for validation of infrared (IR) camera to detect disease in male dairy calves

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Introduction

Body temperature measurement is a key part of the clinical examination of calves and serves as a sensitive indicator of acute inflammatory disease (Malmo et al., 2010; Adams et al., 2013). The standard method to monitor temperature is by taking rectal temperatures, but these measurements are subject to errors, and if manually taken are laborious and disruptive to animal behavior (Burfeind et al., 2010). Use of infrared thermography (IRT) is a plausible alternative to rectal temperatures and could provide a non-invasive method to assess calf health as small changes in temperature may result in substantial amounts of radiated energy that may be detected very accurately using IRT (Stewart, 2005).

The IRT allows for earlier detection of disease than conventional clinical scoring or other biological measurements (Stewart et al., 2005). Early detection of disease with IRT would enable earlier and more targeted treatment of affected animals with antimicrobials, which would improve animal welfare, improve the animal industry economics, and reduce the likelihood of promoting antibiotic resistant microbes through reduced need for secondary treatments and antimicrobial use. Thus, a well-designed trial to validate infrared thermography would be beneficial to the industry.

The objectives of this prospective longitudinal cohort study are to compare the results from IRT and rectal thermography over the first week after arrival to a veal facility, determine the utility of IRT in identifying high-risk calves, and determine the ideal day after arrival to collect body temperature to maximize sensitivity and specificity in identifying calves at high-risk to die or be treated for disease. The hypothesis is that IRT will accurately identify calves at high-risk to die, or be treated for disease, with better accuracy than temperatures collected with a rectal thermometer

Sample Size

A total of 321 calves will be required for the completion of this study. The body temperature data was assumed to have normal distribution and to be within 10% of the true upper and lower population interval. The method for sample size determination described by Hahn and Meeker (1991) for tolerance intervals was used assuming 95% confidence in capturing 95% of the population (Hahn and Meeker, 2011).

Methods

This study will be conducted at Mapleview Agri Ltd with all calves arriving at the veal facility being eligible for inclusion. This facility was chosen due to its close proximity to the University of Guelph and its excellent record keeping and adherences to protocols. Researchers will visit the farm on Mondays and Tuesdays and obtain a list of calves that arrived that day and where they are located. Calves that arrived will be health scored on the first day of entry into the facility. Investigators will evaluate rectal temperature by inserting a thermometer into the calf's rectum and core body temperature will be determined using an infrared thermometer (FLIR One, FLIR Comp., Boston, MA). The infrared thermometer will be placed at a distance of 12 inches away from the calf's eye to ensure consistent measurement. Navel, joint and dehydration level of individual calves will also be evaluated. All health and temperature data will be collected daily by trained researchers at the same time of day for 49 days following arrival. Environmental temperature and humidity will also be collected with a Kestrel meter throughout the study. Calves will be housed individually for 49 days and provided milk at 6 am and 4 pm. Water and grain will be provided ad libitum. Pens are $1m^2$ and have slatted rubber flooring. Measurement of rectal temperature and core body temperature determined by an infrared thermometer will be collected daily for 49 days following arrival.

Statistical and analytical plans

Data will be exported from Excel into STATA15 (Stata/IC Version 15.1 for Mac, StatCorp, College Station, TX). Descriptive statistics will be generated and reviewed for normality and variation. A linear mixed model will be created to evaluate the correlation between the rectal temperature and infrared thermometer and a logistic regression model will be used to evaluate the rectal temperature and infrared thermometer's ability to predict morbidity and mortality. Response Operant Characteristic curves (ROC) will be used determine the optimal cut off values or values with the greatest efficiency.

Ethics and dissemination

Ethical approval will be obtained prior to the start of the trial. Changes to the protocol will be reported as protocol deviations. Health data from individual calves will be communicated to the farm owner on the trial day (ie. Calves in need of treatment or monitoring). Results will be analyzed during the fall of 2019.

References

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