Sponsors

University of Minnesota
College of Veterinary Medicine

College of Agricultural, Food and Environmental Sciences

Extension Service

Swine Center

Editors
W. Christopher Scruton
Stephen Claas

Layout
David Brown

Logo Design
Ruth Cronje, and Jan Swanson;
based on the original design by Dr. Robert Dunlop

Cover Design
Sarah Summerbell

Observations and description of an intervention method affecting death loss rate in all in/all out finishers

I. A. Moreau DVM,[1] P. B. Bahnson DVM, Ph.D.,[2] T. S. Donovan DVM,[3] A. Larriestra DVM, MS,[4] R. B. Morrison DVM, Ph.D.[4]

1Biovet Inc., St-Hyacinthe, Que, 2University of Illinois, Urbana, IL, 3The HANOR Co. Inc., Spring Green, WI, 4University of Minnesota, St. Paul, MN

Introduction

Two multi-site production systems were challenged by an elevated death loss rate. Over a period of three years, the production managers tried over twenty interventions in each system to improve the death loss performance. Our objective is to present the process of decision making when implementing changes to decrease the elevated death loss rate in the finishing system. The process is illustrated by selecting two interventions thought to be effective at decreasing the death loss rate from 7% to 4%. Our goal is to show the situations where such observational studies are appropriate, especially where confounding effects limit the ability to decide which intervention to implement.

Description of the population under study

The observations were made in two batch all in/all out (AI/AO), multi-site production systems. The operation markets 250,000 and 500,000 pigs per year from System I and System II, respectively. A batch of pigs consists of a barn of 1,200 animals. A finishing site has eight barns, with 56 pens of 164 ft^2. There are 8 finishing sites in System I and 16 finishing sites in System II. The finishers receive pigs at 70 days of age and market them at a maximum of 27 weeks of age.

Problem definition

In 1999, Baxter Gutknecht developed an index to combine the physical and marketing performance generated by batches of weaned pigs. Referred to as the "Top Hog Index," it provides a measure of efficiency to help management rate the relative physical and financial performance of growing pigs. Seven ratios compose the Top Hog Index. They are the following:

1. Nursery mortality
2. Finisher mortality
3. Number of pigs sold to a market as substandard
4. Number of pigs dead on arrival, or at the processing plant
5. Number of pigs arriving as "subjects" at the processing plant
6. Number of pigs sold at the processing plant but under the premium market weight
7. Number of pigs sold in the premium grid at the processing plant

Each of the seven ratios above are assigned a value index. The value index is integrated into the seven ratios to determine a single Top Hog Index for each system on a monthly basis. The objective is to achieve a Top Hog Index of 91% or above. In 1999, System I and System II were consistently running five or more index points below target. Based on the Top Hog Index, a change of one index point affects the bottom line profitability by 1 million dollars, or $1.00 per pig marketed in our system.

The operation was not meeting its goal for Top Hog Index mainly due to a high finisher death loss and an elevated proportion of pigs marketed as culls and substandard. The median death loss rate for individual barns during the observation period ranged between 0.68% to 22.0% and 2.94% to 18.2% for Systems I and II, respectively.

Health status

In 1999, the known pathogens present in System I included Porcine Respiratory and Reproductive Syndrome virus (PRRSv), *M. hyopneumoniae*, *S. suis*, *A. suis*, *H. parasuis*, Circovirus type II, *Salmonella* group B, and *L. intracellularis*. The growing pigs were negative for Swine Influenza virus (SIV) H1N1 and not tested for SIV H3N2. The mean prevalence antibody detected for PRRSv and *M. hyopneumoniae* at 20 weeks of age was 92% and 35%, respectively. Although variable by batch, the approximate onset of seroconversion to PRRSv and *M. hyopneumoniae* was 60 and 160 days of age, respectively. The sow herd was vaccinated for *Parvovirus*, *Leptospirosis*, *E. rhusiopathiae*, PRRSv and *Eschericia coli*.

In 2000, the known pathogens present in System II included, PRRSv, *M. hyopneumoniae*, Swine Influenza Virus (SIV) types H1N1 & H3N2, *S. suis*, *H. parasuis* serotypes 4, 5, 13, and non-typeable, *Salmonella* group B and *L. intracellularis*. At 18 weeks of age the prevalence of antibody to PRRSv was 100% and 36% for *M.*

hyopneumoniae. The mean time to seroconversion was 77 days and 126 days for PRRSv and *M. hyopneumoniae*, respectively. At 18 weeks of age, the prevalence of antibodies to Swine Influenza was 20% for H1N1 and 72% for H3N2 (positive cut-off > 80 using HI). Across all parities in the sow herd, the seroprevalence for PRRSv was 94% and 98.5% for *M. hyopneumoniae*, as detected by the Tween 20 ELISA. Sows in System II were vaccinated for PRRSv, *Parvovirus, Leptospirosis, E. rhusiopathiae*, Swine Influenza virus H1N1, and H3N2, *H. parasuis*, and *E.coli*. Pigs were vaccinated while in the nursery for *M. hyopneumoniae, H. parasuis* and SIV H1N1 and H3N2.

Condition of dead pigs and causes of death

The observation period for System I was from January 1997 to December 2000. The median death loss rate during the observation period ranged between 0.68% and 22.0%. Observations on 2,724 dead pigs showed the following:

- 41.3% of the dead pigs were pale, showing signs of perforated ulcers
- 19.7% revealed no outside reasons for death
- 16.6% were cachectic before dying
- 14.9% were grouped into tail bitten, dyspnea, rectal stricture
- 7.42% had a broken leg or an inflamed joint

Pathogens commonly isolated and suspected as causing death in System I were Circovirus, and *M. hyopneumoniae* with secondary infection with *P. multocida*.

The observation period for System II was from June 1999 to December 2000. The median death loss rate during the observation period ranged between 2.94% and 18.2%. In System II, the following mortality observations were made between July 1999 and July 2000. Mortality data from 17,250 pigs described by site managers were as follows:

- 42% of the pigs that died were in the hospital pen, where they were pulled and treated
- 15% of the pigs were noted to have a respiratory involvement
- 37% were pale
- 6% were designated as other which included lameness, inguinal or scrotal ruptures, tail bite injuries, greasy pig disease, and rectal prolapses

In this system, isolated agents most likely involved in pig mortality were SIV, PRRSv, and *M. hyopneumoniae* with secondary infection with *Haemophilus parasuis* and *Streptococcus suis*.

Description of interventions

Interventions included changes in feed medication, pig flow management, change in pig density, modifications to the nursery ventilation system, and vaccination programs for PRRSv, and *M. hyopneumoniae* for System I and Swine Influenza, *M. hyopneumoniae*, and *H. parasuis* for System II.

Antibiotic-free finishing pigs

In System II, each week pigs in two barns per site were designated for production of antibiotic- free pigs. This represented 2,400 pigs per week, which accounted for 12% of the annual production. Barns designated as non-medicated were stocked with gilts; all other aspects of production including genetic distribution, feed formulation, husbandry, and vaccination programs were equal among all pigs in the site. The non-medicated finisher pigs were not given any feed, water, or injectable antibiotics for the entire 17-week finisher phase. Because the death loss rate of female batches was expected to be lower, we purposely allocated gilts to the production of antibiotic free pigs.

Historical performances showed the median death loss rate for female batches placed between January 1997 and December 2000 was 4.26% (4.49% – 5.20%). The median death loss rate for batches of males placed during the same period was 6.41% (6.43% – 7.35%). Furthermore, data from a controlled study on 48 batches assigned to a vaccine study were used to test the effect of sex on death loss rate. The analysis of variance considered the sex, the treatment, and the time of placement as fixed effects and site as random effect. Sex had a significant effect on death loss rate. The least square difference between sex was 3.71%.

The analysis comparing medicated and non-medicated pigs included the performance of 448 batches produced between February 1999 and February 2001. The presence of concurrent controls allowed testing the effect of feed medication on death loss rate. We used a general linear model and considered the covariates site, sex, and quarter of the year. The average death loss rate during this time period for batches not medicated was 6.03%. Feed medication had a favorable effect on death loss rate. The 95% confidence interval of the least square mean was 0.562% and 1.583%. Although antibiotic-free pigs showed a higher death loss rate, we maintained their production as it served a branded product. This information was used to support trying a more expensive feed medication program.

Finisher pulse medication

System II implemented a pulse medication strategy using tiamulin and chlortetracycline to control clinical signs of respiratory disease encountered in mid to late finishing. The information on time of seroconversion to PRRSv and

M. hyopneumoniae, as well as the onset of clinical signs of cough were used to define the pulse medication program. Tiamulin and chlortetracycline were included in the feed for 10-14 days per treatment at weeks 1-2, 5-7, and 9-10 after entry to the finishing barn. To evaluate the effect of pulse medication on death loss rate, we used one incomplete historical control. The control was a subset of thirteen batches marketed between October 1999 and November 1999. The control batches received Tylosin (40 g/t) from 50 to 140 pounds and Bacitracin Methylene Disalicylate (30 g/t) from 140 to 270 pounds. The descriptive statistics for death loss rate are presented in **Table 1**.

The sample size for the control was small because details on the interventions assigned to a batch were not available prior to this time. In addition to time effect, this limited our ability to confirm that pulse medication decreased the death loss rate, a change in the disease status confounded our interpretation. The observed 3.79% reduction in the death loss rate may have been greater, but a disease outbreak occurred during the time pulse medication was implemented. SIV was diagnosed in June 2000 and resulted in an increase in finisher death loss. Subsequent vaccination of the sow herd controlled most of the clinical signs. The SIV outbreak occurred in pulse-medicated batches only.

Effect of pig density on death loss rate

The daily weight gain for batches marketed between June and September were 0.02-0.05 lb/day lower than the gain for batches produced during October through May. A decreased growth rate during this period resulted in 2.4% more pigs not marketed within the desired market weight interval (230 to 285 lb). To increase the proportion of pigs marketed above an average live weight of 250 lb without increasing the facility cost, System II increased the stocking density of the newly placed pigs for four weeks to allow two barns to raise the light pigs until 30 weeks of age. The pigs were placed with 30-32 pigs per pen versus 20-22 pigs per pen. The death loss rate increased following the implementation of temporary pig placement at a 25% higher density. In October, the pig flow management went back to normal. To review the effect of density on death loss rate in System II, we compared but did not test the descriptive statistics for 60 batches of pigs placed at 30-32 pigs per pen against 88 batches of pigs placed at 20-22 per pen before and after the intervention. The median death loss rate for the pigs raised at a higher density or 5.54 ft^2 between 10 and 14 weeks of age was 5.85% (5.50%–6.86%). The median death loss rate for the pigs placed at a lower density or 7.45 ft^2 was 4.64% (4.58%–5.06%).

An underlying seasonal component may have concurrently effected the death loss rate during the period of increased density discussed above. During the time the pig density was increased, the finisher death loss is expected to increase. In fact, based on date marketed, the median death loss rate was 5.30%, 3.65%, 4.13%, and 5.20% for quarters 1, 2, 3, and 4, respectively. Batches of pigs with the highest death loss rate were closed in quarter 1 and 4. They were placed in the finisher in weeks 32 through 45 or mid-August through September. This was the time frame that the increase in pig density was implemented in System II; therefore, the season may have increased the effect we observed from decreasing the pig density.

The effect of pig density was considered again in System I where it was measured on a subset of 40 batches assigned to a vaccine study. The density varied between 22 and 26 pigs per pen. The analysis of variance considered sex, treatment, and time of placement as fixed effects, site as random effect, and the number of pigs per pen (Npen) was considered as a covariate. The P-value for Npen was 0.62. We concluded that, even if variation in pig placement from 7.5 ft^2 to 6.4 ft^2 does not affect the death loss rate, higher density (5.6 ft^2) does negatively impact the death loss rate. As we faced the problem of increased substandard pigs produced in the summer months, we elected to find facilities outside the existing system to raise these pigs until thirty weeks of age.

Conclusions

In an effort to quickly reduce death loss, many interventions were tried in a short period of time. Although controlled trials would have provided more certainty, in the present system each controlled study would have required at least three months of weaned pig production. For example, to give an 80% power to detect a 2% change in mortality, (with a type I error of less than 5%), a sample size of 24 pairs would have been required (the standard

Table 1: Death loss data from batches fed a continuous anti-microbial feed additive program or a pulse anti-microbial feed additive program.

Feed antibiotic program	Number of batches	Mean death loss	SD	95% CI
Continuous medication	13	8.54%	2.57	6.99 – 10.09
Pulse medicated	332	4.74%	2.21	4.51 – 4.98

deviation was 2.38%). In a production system, this amount of time is not economically feasible.

Retrospectively, it is difficult to conclude which of the interventions were essential to the reduction of death loss rate. Ranking based on their apparent reduction in death loss rate from largest to smallest were the following:

- Feed medication strategy
- Vaccination strategy
- Pig flow

We feel that sex and season also have an influence on the death loss rate, but these are factors that we cannot change by therapeutic implementations.

Observational studies similar to those described above are suitable in production medicine as they provide information with a rapid turn around time. This approach can be used to actively engage farm managers in defining the problems and encourages them to participate in implementation of interventions. However, this approach does not allow all aspects of the health and production program to be defined. Confounding effect due to time or concurrent interventions cannot be isolated from the principal intervention studied. Although planned prospective studies provide the most solid evidence for effectiveness of therapies, it is often too difficult to implement controlled clinical studies in a timely and cost effective manner. In light of our experience, our strategy is to perform an observational study to evaluate interventions expected to result in a large effect or during a time when many interventions are applied concurrently. A controlled study should be used to evaluate interventions with an expected small effect, or when they are intended as a cost saving measure.

References

M. Thrusfield. *Veterinary Epidemiology.* Second Edition Ed. Blackwell Science; 1999.

Blue Print Production and Financial Standard. National Hog Farmer, 2000.

Hayes, D. Jensen, H. Fabiosa, J. Backstrom, L. Economic impact of a Ban on the Use of Antibiotics in US Swine Rations. 1999. *Allen D. Leman Swine Conference proceedings* University of Minnesota.

Gutknecht, Baxter. 2001 Personal communication.