RESEARCH REPORT
ANIMAL WELFARE

Title: Assessment of lameness, pain and culling risk in sows – **NPB #07-039**

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Industry Summary:

Lameness has long been identified as a concern in sow herds. It is usually recognized as a painful condition and as potentially detrimental to the future productivity of that sow. Lameness is recognized as one of the main causes of culling and is often frustrating to herd managers and stock persons in that it is difficult to treat and control measures are infrequently identified. Studies in sow lameness are infrequent and are limited by challenges in the creation of repeatable measures for epidemiologic studies.

In this study, our aim was to study and identify methods of measuring lameness and its underlying mechanisms and evaluate culling strategies associated with the identification of lameness. Though there is no gold standard, statistical methods can be used to identify the identifiers of lameness that can be repeatable across sows and herds.

In previous studies we have shown that the use of pain killing drugs eliminates signs of lameness in the great majority of sows. This is an indicator that pain is the major driving force for lameness (as opposed to physical defects). Therefore we used indicators of pain that have been used somewhat successfully in human evaluations of pain. In our hands we did not find a chemical test for pain probably due to the fact that lameness is a chronic condition and the body appears to compensate for the effects of pain.

Conversely, the examination of the gait of sows was productive. Subjective classification of lameness is repeatable especially if minor signs are ignored. Focusing on particular behaviors such as head dipping and identification of affected limbs can add to the accuracy of diagnosis. For sows in stalled housing, weight shifting is also accurate, but does not identify as many sows as lame as the examination of gait. Claw lesions, especially cracks in the wall of the hoof were also correlated with lameness.

As we examined these indicators of lameness, we found that they predicted culling only when there was an adequate supply of sows and gilts to meet the breeding target. Otherwise, they were retained and showed a significantly lower level of productivity. In financial analysis, the output reduction due to this lower reproductive output justified replacement in almost all cases.

This study shows that lameness is a real problem on sow herds and can be addressed by regularly assessing lameness and treating sows where possible. This will not only increase the productivity of the herd but also the well-being of sows and should be a basis to identify preventive and therapeutic interventions.

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Scientific Abstract:

Discussions of animal welfare are often focused on measurable and visible factors such as restrictions on space and movement. However, the most important challenge to the welfare of farmed animals may very well be pain. Lameness is a prevalent condition that is usually due to an underlying painful condition. Pain can also adversely affect productivity. Although in the short term, pain may enhance immune function (and allow the animal to rest (which aids the healing process), ongoing pain can have negative consequences for animal productivity.

The present study aimed to assess the methods of identifying the level of pain and lameness in sows. In order to achieve this, behavioral and biochemical indicators of pain were identified along with those of lameness and the relationship between indicators of lameness and indicators of pain were established. The use of these indicators as a predictor of financial outcome associated with the treatment and retention of sows was also assessed.

In prior studies we had shown that there was a marked decrease in almost elimination of signs of lameness with the use of analgesia in sows. Though this indicated that pain inhibited normal gait and other signs of lameness, we did not find that lameness was correlated with PGE_2 and Substance P in saliva using enzyme immunoassay. In fact only low levels were found, suggesting that these chronic conditions do not result in continued high levels of these biochemical indicators.

Conversely, behavioral assessment of sows was proven to be useful as a predictor of lameness and subsequent productivity. A subjective four grade assessment was assessed using a latent class model and found to have a sensitivity of 71% and a specificity of 90%, with increases seen when further training is focused on head dipping and limping. Diagnostic accuracy was also increased with the use of rubber mats and concrete flooring in combination. The diagnosis was also refined with the identification of defects in the claw wall and a history of low feed intake.

When compared to historic fecundity, fertility and age, the diagnosis of lameness was the strongest predictor of future productivity. In the four great scale of lameness, with the first grade being non-lame, grades two and three were not found to be different and were found to have a future daily productivity that was 41% less than non-lame counterparts. They were also found to have an odds of removal that was 3 ½ times as high as non-lame counterparts.

Objectives:

1. To identify indicators of pain and lameness in sows.
2. To quantify pain in terms of identified indicators of pain and lameness in sows.
3. To estimate the herd-specific performance of the universal gilt and how the expected performance of the universal gilt changes with contemporary herd productivity and lameness risk.
4. To model the ratio of marginal return to marginal investment for the removal-replacement scenarios of age, lameness, fertility and fecundity in the context of contemporary herd fertility and fecundity.

Materials & Methods:

The study was conducted at The University of Minnesota, Southern Research and Outreach Center at Waseca. The research unit is an 800-sow breed to wean facility with individual stalls and group pens with ESF. A bi-weekly weaning system is followed in this unit, and all weaned sows are housed in stalls for a minimum of 10 days before moving to either stalls or to pens with ESF after breeding.

Phase 1: 82 sows with different levels of lameness were randomly selected. Sows showing compromised gait due to congenital or structural deformity were not included in the study. Similarly, downer sows were also excluded. The following indicators of lameness and pain identified based were used in this study.

1. Subjective scoring of gait on a four grade scale
2. Distinct lameness signs, particularly limping and head dipping during walking
3. Weight shifting during standing
4. Claw volume and claw ventral surface area
5. Frequency and duration of postural changes and duration of postural behaviors
6. Flooring effect - the sow was made to walk on concrete and rubber floors to detect presence of compromise in gait as indicated by limping and head dipping.

The observation of sows started immediately prior to farrowing while the sows were in farrowing stalls. Claw measurements were performed prior to farrowing. Four days after mixing, all sows were made to walk individually through a narrow alleyway (without extraneous distractions) into a portioned pen to observe limping and head dipping. A portion of the narrow alleyway was provided with 0.75" rubber mats (18 ft). The sows were retained for 2 hours in the partitioned pen where the frequency and duration of postural changes and duration of postural behaviors will be recorded for 1 hour using a video camera and time-lapse VCR. The above indicators were subjected to latent class analysis to identify indicators with sufficient levels of sensitivity and specificity to be used as lameness indicators.

Phase 2: Using the selected lameness indicators, another 40 lame sows and 80 normal sows were identified and the level of these indicators in these sows will be assessed. The levels of the following pain indicators will also be assessed to assess the level of pain using latent class analysis to identify sensitive and specific pain indicators.

1. PGE_2 in saliva using enzyme immunoassay (Assay Designs, 800 Technology Drive, Michigan 48108 USA).
2. Substance P in saliva using enzyme immunoassay (Assay Designs, Ann Arbor, MI)
3. Daily feed intake
4. Leg injuries other than claw lesions
5. Claw lesions

The identified lameness and chronic pain indicators in the above sows were subjected to correlation analysis. The identified pairs of indicators with high correlation coefficients will be used to quantify the chronic pain associated with lameness.

Phase 3: The results and correlations with productivity were then modeled using a replacement model, also called a universal gilt model, examining the marginal revenues and returns associated with a replacement due to lameness. Expected performance of replacement gilts was based on herd context, comparing low and high productivity levels. A model of marginal return: marginal investment was compared across the different removal categories of lameness, poor fertility, poor fecundity and old age.

Results:

Objective 1:

Using latent class analysis we found that subjective scoring is a useful indicator of lameness. Sensitivity was estimated to be 71% and specificity was estimated to be 90% when personnel were trained using a four-minute video to differentiate between four classes of lameness from 0 to 3. Overall prevalence was estimated to be 46%. Claw volume or ventral surface area was not found to be correlated with lameness. An identifiable compromise of a limb (limping) was found in 55% of lame animals and they head dip was found in 30%. Weight shifting, when assessed within stalls was found in 61% of lame animals, as identified using latent class analysis. More detailed analysis of postural changes and postural behaviors did not show any significant differences except in the severely lame sows where rising behavior and duration of standing were significantly decreased. When a floor test was performed, comparing signs of lameness on slatted floors with rubber mat flooring, clinical signs were eliminated in 62% of the sows.

Objective 2:

No significant differences were found in salivary PGE_2 or Substance P between the lame and non-lame sows. Daily feed intake was only significantly decreased in grade 2 and 3 sows, as measured by number of days consuming less than 1 kg of feed. The odds of consuming less than 1 kg in a day of lactation increased by 97%. Leg injuries were in frequent and were not correlated with lameness. However claw lesions were significantly associated. The claw lesions of concern were defects of the claw wall, commonly called vertical or horizontal cracks. The odds of being diagnosed as lame were increased by 8% with the existence of a single defect.

Objective 3:

The value of an incoming gilt was estimated based on expected performance due to varying lameness prevalences. The formulation was based on:

- The expected likelihood of culling a lame sow after identification
- The performance of a lame sow between the time of identification and removal from the herd, either through culling or death
- The expected likelihood of becoming lame

As expected herd productivity increased, so did the cost of lameness. However, under all scenarios lameness had a large effect on future financial performance of the herd. Figure 1 shows the expected marginal profit under the conditions of weaned pig values of $30 and varied lameness rates and expecteted PSY.

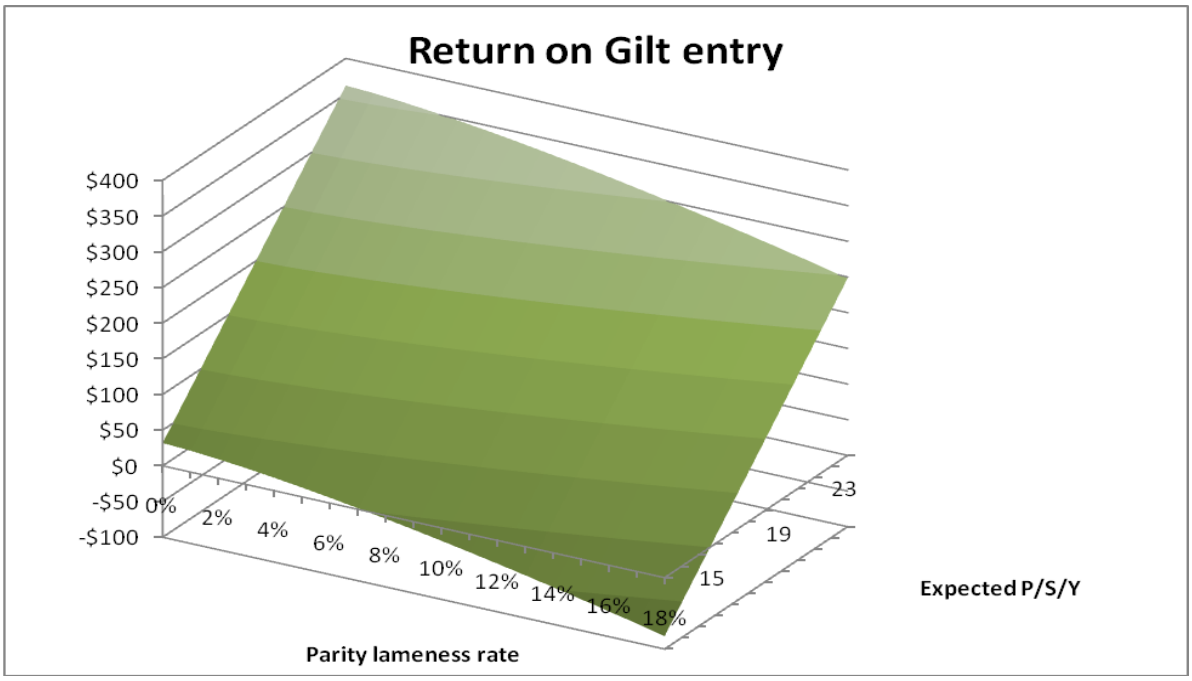

Figure 1: return per gilt entered based on expected performance and lameness ratee

Objective 4:

The predictiveness of historic fertility, fecundity, as well as parity and lameness diagnosis were compared. Historic fecundity and fertility were found to have insignificant predictive capability for future profitability in comparison to lameness and parity that is greater than seven. Calculations to estimate the effects upon marginal revenue per sows space were based on the assumption of a herd productivity of 20 pigs per sow space per year. Retention of sows that deviated greater than 10 piglets from mean cumulative productivity for a specific parity resulted in an estimated $21 decrease in marginal revenue for that space. Likewise, retention of sows that had cumulative returns of two or more had an estimated $19 decrease in marginal revenue for that sow space. For the retention of lame sows this number jumped to $246 and the retention of old sows (>7 parities) had a loss of $107.

Discussion:

The study of a condition is always augmented by a an accurate and repeatable measure. This same was not met in this study. We have not created a new gold standard but have illustrated that, even within the limits of a restricted diagnostic capability, subjective evaluation of lameness is predictive of subsequent performance and profitability. Furthermore, though we have long identified as pain as a significant factor in the modification of behavior that identifies lameness, we have not found the standard of biochemical identification of pain to be applicable in this condition. It is our contention that the gold standard for identification of pain should continue to be the use of analgesia and its effect upon behaviors.

Lameness appears to be best identified through gait analysis, with a close second being the examination for weight shifting during standing in stalls. The latter does take more time, and may not be readily acceptable in commercial situations. Identification of lameness can be augmented through the use of comparison of gait on rubber mats and concrete floors. It can also be augmented by the examination of claws for lesions. Much of the accuracy of gait analysis is gained through signs of limping or head dipping.

Even though the accuracy of lameness can be improved, the conditions associated with its diagnosis are of the scale that cannot be neglected. Lameness has a large effect upon subsequent performance and retention likelihood. In terms of predictability, lameness is much more useful as a culling guideline than historic fertility and fecundity rates, and must be much more of a focus. Though parity can be a predictive factor after parity seven, even in this case the welfare of the sow may need to take precedent over parity concerns.

This study validates the concerns that the industry has about lameness. Though it does not identify final control measures, hopefully it does allow for further studies in prevention and treatment. Such studies should not only improve the productivity of the herd, but it's well-being as well.