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Accuracy of sow culling classifications reported by lay personnel on commercial swine farms

Abstract
Objective—To determine the accuracy of sow culling classifications reported by lay personnel on commercial swine farms.

Design—Retrospective cohort study.

Animals—A convenience sample of 923 sows from 8 conventional, farrow-to-wean farms that followed standard operating procedures.

Procedures—Sows were examined at slaughter, and lesions were recorded. Individual production records were reviewed to determine the farm-reported reason for culling the sows, and criteria were developed to assess the accuracy of recorded culling classifications.

Results—For 209 of the 923 (23%) sows, the farm-reported culling classification was judged to be inaccurate. The culling code was considered to be inaccurate for 62 of 322 (19%) sows reportedly culled because of old age, 48 of 172 (28%) sows reportedly culled because of failure to conceive, 31 of 90 (34%) sows reportedly culled because of poor body condition, and 23 of 73 (32%) sows reportedly culled because of poor farrowing productivity.

Conclusions and Clinical Relevance—Results suggested that for commercial swine farms, farm-reported culling code classifications were frequently inaccurate. This degree of inaccuracy may cause severe limitations for studies that rely on farm-reported assessments of clinical conditions.

Disciplines
Agriculture | Animal Sciences | Large or Food Animal and Equine Medicine | Veterinary Preventive Medicine, Epidemiology, and Public Health

Comments
Poor sow longevity in commercial pork production systems can lead to economic inefficiency and animal welfare concerns. In the United States, mean annual breeding female replacement rate has exceeded 66% for the past several years, suggesting that more information is needed on reasons for sow culling. Traditionally, culling studies have been based on retrospective analyses of farm data because such data are relatively easy and economical to obtain. Often, the integrity of farm culling data is examined by checking for farm inventory changes and missing records. However, the accuracy of farm culling data has not been thoroughly investigated. Accuracy of farm culling data is essential when such data are used by producers to make business and management decisions or by researchers to quantify the economic importance of various culling factors and other key production indicators. The purpose of the study reported here was to determine the accuracy of sow culling classifications made by lay farm personnel on commercial swine farms in the United States.

**Materials and Methods**

A convenience sample of 923 sows from 8 farrow-to-wean farms in integrated production systems in the United States was evaluated (Table 1). All 8 farms used standard operating procedures that were consistent among farms. As part of the standard operating procedure for each farm, sows were individually identified on the farm with an ear tag imprinted with a unique numeric identifier applied at the time the decision was made to cull the sow from the farm. Additionally, all sows had a production tag with a unique numeric identifier applied at the farm of origin. Sows were culled on a weekly basis and sent to a central sow sorting facility where they were incorporated into truckload deliveries to multiple slaughter plants.

For the present study, the investigators visited 2 large Midwest swine finishing operations 6 times each between April and September and evaluated culled sows that arrived as part of the normal deliveries each day that the investigators were present. During each visit, all sows with a culling tag specific for 1 of the 8 previously identified farms were included in the study, except that female pigs that had not produced a litter were excluded from the study.

For each sow included in the study, a complete slaughter examination that included examination of the feet, skin in the shoulder region, respiratory tract, and reproductive tract was performed. A BCS ranging from 1 (thin) to 5 (fat) was assigned by 2 individuals with extensive experience evaluating livestock on the basis of standard criteria for evaluating sows during gestation.
To determine the accuracy of farm-reported culling classifications made by lay personnel on each farm, individual production records for sows included in the study were obtained for each sow. Culling codes had been established by the farm management and were restricted to the following categories by management: old age, did not conceive, anestrus, poor body condition, lameness, farrowing productivity, not found, cesarean section, prolapse, management, sudden death, other illness, and unknown. Managers were required to assign one of these codes to all animals that were culled from the farm and were not able to assign additional or alternative codes. Managers were only allowed to specify a single culling code for each sow; even when more than one category might have been appropriate.

Evaluation of farm-reported culling codes—A culling code of old age was considered to be accurate if the sow was greater than parity 5 at the time of culling. The cutoff of parity 5 was selected because sows have been shown to reach maximum body weight at parity 5 and it can be argued that sows culled when or before they reach their maximum body weight are not truly old. A culling code of anestrus was considered to be accurate if the sow was culled ≥ 8 days after weaning. This cutoff was selected because 8 days has been suggested to be the upper limit of the normal range for weaning-to-estrus interval and anestrus could not be definitively determined prior to this time with available farm resources. A culling code of poor body condition was considered to be accurate if BCS at the time of slaughter was < 3. A culling code of farrowing productivity was considered to be accurate if the sow was parity 2 or greater at the time of culling. First-parity sows should not be culled for poor farrowing productivity because litter performance factors such as number born alive, number weaned, piglet mortality rate, and first-parity 21-day litter weight have low heritability and repeatability and the variation in litter performance among first-parity sows is largely influenced by environmental factors.

Farm No. | Farm capacity | Farm inventory | Recording system | No. of sows enrolled | Annual sow replacement rate (%)
---|---|---|---|---|---
1 | 5,000 | 5,180 | Porcetec | 93 | 64
2 | 5,000 | 5,284 | Porcetec | 136 | 51
3 | 11,000 | 11,399 | PigCHAMP | 291 | 50
4 | 2,500 | 2,435 | Pigtails | 41 | 43
5 | 2,500 | 2,440 | Pigtails | 69 | 45
6 | 5,000 | 5,140 | PigCHAMP | 124 | 46
7 | 2,500 | 2,568 | PigCHAMP | 60 | 46
8 | 2,500 | 2,598 | PigCHAMP | 109 | 43

*Approximate number of sows each farm had the capacity to house. *Number of sows on each farm on May 10, 2006. *Commercial record-keeping system used by each farm. *Number of sows from each farm enrolled in the present study.

A culling code of cesarean section was considered to be accurate unless otherwise indicated in the production record or unless the sow was found to be pregnant at the time of slaughter. In addition, culling codes for old age, anestrus, poor body condition, farrowing productivity, and cesarean section were considered accurate only if the sow had been culled ≤ 21 days after weaning. It was considered unlikely that sows that truly had been culled for any of these reasons would be allowed to remain in the herd for a prolonged period after weaning. However, because slaughter plants discourage the marketing of lactating sows, a period of up to 21 days after weaning was allowed, as this period was considered sufficient to allow sows to cease lactating.

A culling code of did not conceive was considered to be accurate if the sow was culled ≥ 45 days after weaning. For farms included in the study, sows were allowed to remain in the herd for 45 days after weaning, unless culled for another reason, before being culled for failing to conceive. This period had been selected by farm management by adding 3 days for an early return to estrus after weaning to the time required for 2 typical 21-day estrus cycles. Hence, the standard operating procedure for the farms was to give sows 2 consecutive estrus cycles to conceive before culling them for failing to conceive.

Culling codes for lameness, prolapse, other illness, and management were considered accurate without further evaluation, as reliable information to evaluate the accuracy of these culling codes was not available. In particular, the presence or absence of lameness was not recorded at the slaughter plants. However, the presence or absence of front and hind foot lesions was evaluated during the slaughter examination, and these data were compared for sows that were classified as lame or not lame. For these purposes, cracked hooves were defined as any hoof wall cracks, including side wall lesions and cracks in the white line and toes. Heel lesions were defined as described by Gjein and Larsen. Feet were examined for abscesses on any surface of the foot, and hooves and dew claws were evaluated for abnormal growth conditions (eg, digital overgrowth). Missing dew claws were recorded. The presence or absence of prolapses was not reliably recorded, although some were observed during slaughter examination. The cul-
The culling codes of not found, unknown, and sudden death were always considered to be inaccurate because sows had been shipped to the slaughter plant. Therefore, they must have been found, had been culled for some reason, and had not died on the farm.

Investigators assumed that farm personnel properly recorded farrowing, weaning, and culling dates, as these did not require an interpretive assessment. Culling dates were verified by comparing the farm cull date to the date sows were evaluated at the slaughter plants.

Statistical analysis—For each culling code, the percentage of sows for which that culling code was inaccurate was calculated. General linear procedures were used to compare the prevalence of front and hind foot lesions among sows culled because of lameness with the prevalence of such lesions among sows culled for any other reason. Farm and parity were included in this analysis as fixed effects. All analyses were performed with standard software. Values of $P < 0.05$ were considered significant.

Results

Overall, 923 sows were evaluated. This included 281 sows examined at the first slaughter plant and 642 examined at the second slaughter plant. Culling codes were considered to be inaccurate for 209 of the 923 (23%) sows evaluated.

For 322 of the 923 (35%) sows, old age was recorded as the culling code, but this was considered to be inaccurate in 62 of the 322 (19%). For 12 of these 62 sows, the culling code was considered inaccurate because the sow was culled > 21 days after weaning and was parity 5 or less at the time of culling; for 40 of these sows, the culling code was considered inaccurate because the sow was culled > 21 days after weaning; and for 10 of these sows, the culling code was considered inaccurate because the sow was parity 5 or less at the time of culling.

For 172 of the 923 (19%) sows, did not conceive was recorded as the culling code, but this was considered to be inaccurate in 48 of the 172 (28%) because they were culled < 45 days after weaning. Forty-three of these 48 (88%) sows were culled between 29 and 44 days after weaning, indicating that they may have been provided a single opportunity to conceive.

For 123 of the 923 (13%) sows, anestrus was recorded as the culling code, but this was considered to be inaccurate in 7 of the 123 (6%) because they were culled < 8 days after weaning. Fifty-nine of the 123 (48%) sows culled for anestrus were culled within 30 days after weaning.

For 90 of the 923 (10%) sows, poor body condition was recorded as the culling code, but this was considered to be inaccurate in 31 of the 90 (34%) because they had BCs ≥ 3 at the time of the slaughter examination. Thirty-two of the sows culled because of poor body condition had a BCS of 2 at the time of slaughter. Of the 73 sows observed to have a BCS of 1 at the time of slaughter, 27 (37%) were reportedly culled because of poor body condition.

For 73 of the 923 (8%) sows, farrowing productivity was recorded as the culling code, but this was considered to be inaccurate in 23 of the 73 (32%). Of the 23 misclassified sows, 16 were culled > 21 days after weaning, 5 were parity 1 at the time of culling, and 2 were culled > 21 days after weaning and were parity 1 at the time of culling. In addition to the 23 misclassified sows, 16 of the 73 (22%) sows for which farrowing productivity was the culling code had mean numbers of pigs born alive per litter greater than the study mean (10.93).

For 15 of the 923 (2%) sows, cesarean section was recorded as the culling code, but this was considered inaccurate in 14 of the 15 (93%), including 13 found to be pregnant at the time of slaughter. All 15 sows for which the culling code was cesarean section came from a single farm, and 14 of the 15 had been culled on the same day.

The culling code was recorded as lameness in 83 of the 923 (9%) sows, as prolapse in 11 (1%), as management in 2 (0.2%), and as other illness in 8 (1%). For all of these sows, the culling code was considered to be inaccurate.

The culling code was recorded as not found in 18 of the 923 (2%) sows, as unknown in 5 (1%), and as sudden death in 1 (0.1%). Culling codes were considered to be inaccurate in all 24 of these sows.

Mean total number of front foot lesions among sows with a culling code of lameness (0.70) was not significantly different from mean total number of front foot lesions among sows with all other culling codes combined (0.58). Similarly, mean total number of hind foot lesions among sows with a culling code of lameness (1.19) was not significantly different from mean total number of hind foot lesions among sows with all other culling codes combined (1.16).

Discussion

Results of the present study suggested that a high proportion of sow culling classifications recorded by lay farm personnel on commercial swine farms in the United States were inaccurate. In the present study, farm-reported culling codes were inaccurate for 209 of the 923 (23%) sows. This suggests that there may be severe limitations for studies that rely on farm-reported assessments of clinical observations.

Farms included in the present study had established a policy that sows be given 2 consecutive estrus cycles to conceive before they were culled for failing to conceive. This was in accord with generally accepted principles of sow management, as weaning-to-farrowing interval has been found to have low heritability and repeatability (0.04 to 0.06). In the present study, the culling code was considered to be inaccurate for 48 of the 172 (28%) sows reportedly culled for failing to conceive. Further investigation indicated that 43 of these 48 (88%) sows had been culled between 29 and 44 days after weaning, indicating that contrary to farm manage-
ment policy, they may have been provided only a single opportunity to conceive before being culled.

During slaughter evaluations, 146 of the 172 (85%) sows reportedly culled because of failing to conceive and 103 of the 123 (84%) sows reportedly culled because of anestrus had grossly normal ovaries. Gross appearance of the ovaries at slaughter was not used to determine whether culling codes were accurate or inaccurate because sows with grossly normal ovaries may not have been exhibiting behavioral estrus or may have aborted. Nevertheless, the high percentage of grossly normal ovaries in sows culled for reproductive failure remained unexplained, although feeding and breeding management practices and sow genetics may have played a role.

For 14 of the 15 sows reportedly culled because of anestrus in the present study, the culling code was considered to be inaccurate. Because all 15 of these sows came from a single farm, with 14 having been culled on the same day, it is possible that this farm had a data entry problem or simply used this culling code for excess sows it wanted to remove.

Similarly, 17 of the 18 (94%) sows with a culling code of not found were from a single farm, suggesting that there may have been a problem properly coding the reasons for culling sows or an organizational problem. Improved record-keeping systems for culling could help eliminate organizational issues.

In the present study, we used standard criteria for evaluating the accuracy of culling codes for all 8 farms included in the study. We acknowledge that appropriate culling code criteria may vary from one farm to the next on the basis of various conditions. For example, economic conditions may allow a farm to retain a sow culled for anestrus longer than the 8 days used as a cutoff in the present study. Thus, reported percentages of inaccurate culling codes in the present study may be overestimations in some instances. Nevertheless, our findings strongly support the suggestion that a large proportion of farm-reported culling codes may be inaccurate.

A second important limitation of the present study concerned the practice of having farms assign a single culling code for each sow, as this forced farm personnel to make an interpretative determination of the primary cause for culling. We acknowledge that multiple factors or causes may have contributed to any individual sow being culled. Additionally, we recognize that variability in the qualification of farm personnel to make this interpretation is a reality. However, assessing this variation in expertise was not possible with the available data and beyond the scope of the present study. Limiting on-farm personnel to a specific menu of culling codes, as the farms in this study did, has been done to facilitate data entry into and summarization by database applications. This may force farm personnel to misclassify an animal despite knowledge of the cause of culling for the animal. Information to assess this potential impact was not available in the present study.

A truly random sample of culled sows would have been preferable to the convenience sample of limited farms used in the present study. However, not all farms are willing to share data about culled animals that are shipped to slaughter. Additionally, reliably identifying individual animals and matching them with their specific production records required that farms willing to identify sows prior to shipment be used in the study.

Communicating with farm managers the proper reasons for culling is important for sow longevity and farm data precision. Data integrity and transparency of culling decisions is important for accurate farm management and business decisions. High-parity sows should likely not be culled for old age. Rather, the specific reason these sows were culled, such as reproductive failure or poor litter performance, should be recorded to better understand the reasons for culling older sows. Improper and unnecessary culling increases development costs and biosecurity risks associated with bringing a larger number of replacement animals into the herd. Concern over the precision of farm records for culling is raised from the magnitude of errors observed in the present study.

References