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Assessing sow mortality

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Introduction

A trend of rising sow mortality has been recognized in some herds and production systems. Other herds with similar genetics, nutrition, management, facilities, and climate have maintained "normal" mortality numbers, causing practitioners and producers to ask, "Why?" To address this question, a team was assembled consisting of experts in epidemiology, statistics, gross pathology, histology, practical modern production, and nutrition. Using production record analysis and pathology exams as basic tools, the team sought to probe the following questions regarding sow mortality:

- How do sows die?
- Why do sows die?
- When do sows die?
- What is "normal" mortality in modern US production?

Gathering data

The team reviewed industry, system, herd, and individual sow trends over the last three years. Approximately four million parity records representing modern pork production across the United States were examined. These records covered a variety of production systems, geography, facilities, management, and nutrition. Details of that review are provided in another paper within this session.

The pathology segment gathered information based on gross and histologic examinations. At the time of writing, nearly 275 post-mortem exams have been conducted, taken from a cross-section of modern swine production in the United States, and also representing a variety of systems, geography, facilities, management, and nutrition. During an eight-month period, necropsies were performed at six geographic locations representing eight separate production systems. Two to four days were spent at each location where a team of veterinarians performed post-mortem examinations on sows that had recently died or been euthanized.

At necropsy, a standard set of 21 tissue samples was collected from each subject. Additional tissue samples were gathered when appropriate. Backfat was measured and recorded for each subject (10th rib, 6 cm from midline). Pertinent historic information and details of the gross findings were recorded for each subject. Digital images were recorded where appropriate. Specifics of the necropsy and tissue preparation protocol have been written and submitted for publication (Pretzer, *Swine Health and Production*).

Histologic examination was performed on tissues from selected subjects. Selection was based on observations of developing patterns or uniqueness of the individual case. Details of the histology review are provided in another paper within this session.

Table 1: Apparent cause of death or reason for euthanasia

				Musculo-skeletal		Gastro-intestinal		Repro system		Respiratory system		Cardiovascular system*		Urinary system		Nervous system		Accident		Other		Unknown	
Location	Number examined	Number died	Number euthanized	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	34	25	9	5	14.7	5	14.7	3	8.8	8	23.5	1	2.9	4	11.8	0	0.0	1	2.9	5	14.7	2	5.9
2	32	16	16	12	37.5	3	9.4	4	12.5	3	9.4	2	6.3	0	0.0	0	0.0	1	3.1	3	9.4	4	12.5
3a	24	0	24	11	45.8	1	4.2	0	0.0	5	20.8	0	0.0	1	4.2	0	0.0	0	0.0	0	0.0	6	25.0
3b	20	3	17	8	40.0	0	0.0	2	10.0	3	15.0	0	0.0	0	0.0	0	0.0	0	0.0	2	10.0	5	25.0
3c	17	6	11	8	47.1	1	5.9	3	17.6	0	0.0	1	5.9	0	0.0	0	0.0	2	11.8	0	0.0	2	11.8
4	38	12	26	8	21.1	13	34.2	5	13.2	4	10.5	3	7.9	0	0.0	0	0.0	0	0.0	2	5.3	3	7.9
5	31	11	20	10	32.3	5	15.1	6	19.4	0	0.0	1	3.2	1	3.2	0	0.0	0	0.0	6	19.4	2	6.5
6	76	22	54	42	55.3	7	9.2	10	13.2	4	5.3	3	3.9	0	0.0	0	0.0	0	0.0	2	2.6	8	10.5
Totals	272	95	177	104	38.2	35	12.9	33	12.1	27	9.9	11	4.0	6	2.2	0	0.0	4	1.5	20	7.4	32	11.8

*Cardiovascular system category includes septicemia

Results: Gross necropsy observations

Gross necropsy observations are summarized in **Tables 1–6**. Wide ranges are recognized among the locations in every category in all tables.

Table 1 summarizes the apparent cause of death or reason for euthanasia by category for each location. Overall, musculo-skeletal problems were identified most frequently as the cause of the subject's demise (38.2%), yet the locations varied in this category from 55.3% (location 6) to 14.7% (location 2). Gastro-intestinal problems were identified as the second most common cause of death or euthanasia overall (12.9%), yet the locations varied from 34.2% (location 4) to 0% (location 3b).

Table 2 summarizes the parity distribution of the subjects by location. Parity distribution varied widely among locations. P0 and P1 females accounted for 32.7% of the subjects overall but ranged from 5% (location 3b) to nearly 58% (location 4).

Table 3 summarizes the backfat measurements by range, for each location. Fat thickness varied widely among locations. Subjects from locations 3b, 4, and 5 were notably low in backfat, with high percentages less than 12 mm (55%, 52%, and 64% respectively). Location 1 subjects were high in backfat, with nearly 30% greater than 25 mm.

Table 4 summarizes the observations of gastric epithelium (aglandular, cardia region) by character for each location. Some subjects exhibited more than one characteristic (e.g., keratinized and eroded), and thus appear in more than one category. Fatal sequellae such as severe pleuritis (due to a ruptured esophagus) were also seen. The "severe stricture" category indicates stricture of the cardia at the end of the esophagus, with or without hypertrophy of the esophageal musculature. Wide variation exists between locations—for example, location 4 subjects had 0% normal epithelium, yet location 2 had 81% normal epithelium.

Table 5 summarizes the observations of articular surfaces (right coxo-femoral joint) by character for each location. This table presents perhaps the greatest variation between locations. For example, at location 2, 100% of the joints examined were considered normal; however, at location 3b only 15% were considered normal.

Table 6 summarizes the observations of reproductive status (based on ovarian activity and uterine character) for each location. The "retained feti" category indicates that one or more piglet carcass or skeleton (macerated fetus) was found in the uterus days after the majority of the litter had been delivered. These sows are identified elsewhere in the table, depending on ovarian activity (anestrus, cycling, lactating, etc.)

Note that 58.5% of all subjects were not pregnant or lactating (cycling/open and anestrus categories). At location

Table 2: Parity distribution of subjects

Location	Number examined	P0		P1		P2		P3-8		P>8		Unknown	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	34	0	0.0	8	23.5	8	23.5	17	50.0	1	2.9	0	0.0
2	32	6	18.8	6	18.8	2	6.3	15	46.9	1	3.1	2	6.3
3a	24	1	4.2	3	12.5	10	41.7	9	37.5	0	0.0	1	4.2
3b	20	0	0.0	1	5.0	3	15.0	15	75.0	1	5.0	0	0.0
3c	17	1	5.9	2	11.8	2	11.8	11	64.7	0	0.0	1	5.9
4	38	11	28.9	11	28.9	2	5.3	13	34.2	1	2.6	0	0.0
5	31	0	0.0	4	12.9	7	22.6	16	51.6	2	6.5	2	6.5
6	76	9	11.8	26	34.2	9	11.8	23	30.3	2	2.6	7	9.2
Totals	272	28	10.3	61	22.4	43	15.8	119	43.8	8	2.9	13	4.8

Table 3: Backfat measurements

Location	Number examined	<12mm		12 - 18mm		19-25mm		>25mm		Not recorded	
		No.	%	No.	%	No.	%	No.	%	No.	%
1	34	3	8.8	6	17.6	9	26.5	10	29.4	6	17.6
2	32	5	15.6	12	37.5	5	15.6	6	18.8	4	12.5
3a	24	2	8.3	12	50.0	6	25.0	4	16.7	0	0.0
3b	20	11	55.0	5	25.0	2	10.0	1	5.0	1	5.0
3c	17	5	29.4	7	41.2	3	17.6	2	11.8	0	0.0
4	38	20	52.6	14	36.8	2	5.3	2	5.3	0	0.0
5	31	20	64.5	5	16.1	5	16.1	0	0.0	1	3.2
6	76	14	18.4	30	39.5	20	26.3	11	14.5	1	1.3
Totals	272	80	29.4	91	33.5	52	19.1	36	13.2	13	4.8

Table 4: Gastric epithelium status (aglandular cardia region)

Location	Number examined	Normal		Keratinized		Eroded		Ulcers (Moderate/Severe)		Ulcer as apparent COD or RFE		Strictures	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	34	19	55.9	4	11.8	5	14.7	5	14.7	2	5.9	0	0.0
2	32	26	81.3	0	0.0	2	6.3	3	9.4	1	3.1	0	0.0
3a	24	1	4.2	14	58.3	10	41.7	12	50.0	1	4.2	0	0.0
3b	20	2	10.0	11	55.0	8	40.0	5	25.0	0	0.0	4	20.0
3c	17	3	17.6	11	64.7	4	23.5	7	41.2	0	0.0	1	5.9
4	38	0	0.0	20	52.6	19	50.0	14	36.8	3	7.9	5	13.2
5	29	7	24.1	11	37.9	9	31.0	8	27.6	0	0.0	1	3.4
6	75	17	22.7	40	53.3	15	20.0	20	26.7	4	5.3	1	1.3
Totals	269	75	27.9	111	41.3	72	26.8	74	27.5	11	4.1	12	4.5

Note: Subjects may appear in more than one category (e.g., eroded and keratinized)

Table 5: Coxo-femoral joint (articular cartilage characteristic)

Location	Number examined	Normal		Mild damage		Moderate damage		Severe damage		Damage as apparent COD or RFE	
		No.	%	No.	%	No.	%	No.	%	No.	%
1	34	30	88.2	0	0.0	4	11.8	0	0.0	0	0.0
2	32	32	100.0	0	0.0	0	0.0	0	0.0	0	0.0
3a	24	15	62.5	3	12.5	4	16.7	2	8.3	0	0.0
3b	20	3	15.0	8	40.0	7	35.0	2	10.0	0	0.0
3c	17	5	29.4	7	41.2	2	11.8	3	17.6	1	5.9
4	38	19	50.0	7	18.4	7	18.4	5	13.2	3	7.9
5	31	12	38.7	5	16.1	5	16.1	9	29.0	2	6.5
6	75	24	32.0	14	18.7	25	33.3	12	16.0	3	4.0
Totals	271	140	51.7	44	16.2	54	19.9	33	12.2	9	3.3

Table 6: Reproductive status of subjects

Location	Number examined	Cycling (open, not lactating)		Bred <30d.		Bred 30d - 90d		Bred >90d		Lactating		Anestrus		Retained Feti	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	29	9	31.0	6	20.7	2	6.9	2	6.9	7	24.1	3	10.3	3	10.3
2	21	5	23.8	0	0.0	4	19.0	0	0.0	11	52.4	1	4.8	3	14.3
3a	24	6	25.0	1	4.2	7	29.2	1	4.2	7	29.2	2	8.3	0	0.0
3b	20	13	65.0	1	5.0	2	10.0	0	0.0	2	10.0	2	10.0	0	0.0
3c	16	9	56.3	1	6.3	1	6.3	1	6.3	2	12.5	2	12.5	1	6.3
4	39	19	48.7	1	2.6	6	15.4	5	12.8	3	7.7	5	12.8	4	10.3
5	30	23	76.7	0	0.0	2	6.7	2	6.7	1	3.3	2	6.7	4	13.3
6	74	45	60.8	0	0.0	5	6.8	11	14.9	11	14.9	2	2.7	5	6.8
Totals	253	129	51.0	10	4.0	29	11.5	22	8.7	44	17.4	19	7.5	20	7.9

5, these groups accounted for 83.4% of the subjects examined.

Discussion

Sow necropsies were performed at each location over a 2–4 day period. The number of animals entered in the study from each system was limited by the availability of sows during that week. Although a week of post-mortems may not be indicative of a system's long-term problems, the data represents a snapshot, a momentary glimpse of each system's situation at that time.

Reviewing the data, each system has its own unique set of sow mortality challenges. No single problem stands out among all systems. The differences between locations suggest that post-mortem findings (including cause of death/reason for euthanasia) are influenced by several factors, some of which demand future investigations.

Variations in husbandry, nutrition, geography, environment, etc. influence the outcome of these post-mortems. Additional evaluation and research are warranted.

This exercise also revealed two phenomena which are apparently fairly common, yet not well documented or understood—splenic encapsulation and strictures of the gastric cardia. In ten cases (5/8 systems), a portion of the spleen or the entire spleen was encased in a thick fibrous capsule. Within the capsule, the splenic tissue was soft, friable, and apparently degenerating. The etiology of these this splenic pathology is unknown to the authors. It is hoped that additional cases and histologic examinations will yield a better understanding of the pathophysiology. In twelve cases (5/8 systems), there were dramatic strictures of the gastric cardia. In some subjects, the opening to the stomach was reduced to 1–2 mm, making passage of solid food unfeasible. Hypertrophy of the esophageal musculature accompanied the strictures in some, but not all, cases. These strictures are believed to be sequellae of previous ulcerating episodes. Further investigation into the frequency, etiology, and impact of these phenomena is warranted.

Lessons learned: A practitioner's perspective

After combining necropsy data with individual histories, management practices, and system characteristics, basic truisms become apparent. These truisms may seem self-evident. Indeed, this exercise teaches the experienced observer that which is already known.

Mortality and culling practices are inextricably intertwined. In some cases, mortality is the outcome of a conscious culling decision. Mortality is a function of (among other things) distance from a sow slaughter facility and the frequency of trips made to that facility.

Convenience must not undermine good husbandry. Nipple waterers and drop feeders are examples of technologies that allow labor to be more efficient. However, reducing labor must never interfere with proper care of the animals. A vicious cycle begins when these systems fail to function properly (e.g., plugged nipples), depriving sows of feed or water. At some point, one must ask, "Which came first, the down sow that cannot rise to eat or drink? Or the deprived sow that cannot rise because of the deprivation?"

Production targets should not be counter-productive. When excessive emphasis is placed on any singular production parameter, other parameters will suffer. When financial incentives are attached (e.g., bonuses), the temptation is great to perform well in one area at the expense of others. Breeding targets (number of sows mated per unit of time) may encourage mating (and consequently retaining) undesirable females purely for the sake of achieving the target. These females may be farrowing complications, too thin, too fat, too old, structurally unsound, etc. As a consequence of the decision to retain the sow, her condition may deteriorate and she may eventually die. If there is no impact to the breeder as a consequence of the eventual fall-out, the behavior is encouraged.

Improper development and acclimatization undermine long-term productivity. Joint damage, gastric ulcers, foot and leg trauma, endocarditis, and pleural adhesions are examples of problems that might begin during the development of replacement gilts. But these same factors may cause reproductive and viability problems later in life

Selection standards must not be lowered. Clearly, this is a possibility within a genetic company, but there is a greater potential within closed-herd multipliers and user-groups. Actually, the worst example observed was a herd purchasing breeder-weaner animals.

Sows must be fed correctly through lactation and gestation. The science of feeding sows has never been more important than now—when high productivity is demanded of each female. Body condition scores can be misleading. Backfat thickness can be used as a reference to proper feeding. Close communication with nutrition consultants and suppliers is crucial. Using scale tickets from feed deliveries over an extended period to calculate daily intakes per sow is a better method than using individual sow cards and feeding estimates.

Gastric ulcers kill sows. Irrespective of etiology, damage to the gastric epithelium is the most common finding in this study. When ulcers are found to cause an unacceptable percentage of the deaths, all contributing factors should be evaluated. This study indicates that ulcer "paradigms" may be inappropriate.

Vaccine and treatment decisions must be made judiciously. Withdrawal times may prevent timely culling and slaughter, thus adding to sow mortality.

Conclusions

This study has provided insight into several systems with elevated sow mortality. As consultants and health professionals, we must critically evaluate the accepted practice of speculating or presuming causes of sow death. There is no universal "magic bullet" to improve sow viability. Before we can create strategies to reduce death loss, we must first have a clear understanding of the problems.