# Proceedings
of the

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# ONTARIO SWINE CONFERENCE

**March 25-26, 2025**

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Ontario Pork Industry Council

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# Proceedings

*of the*

# ONTARIO SWINE CONFERENCE

*Edited by*

J.H. Smith and M. Henry

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We greatly appreciate the ideas and input from the industry participants who attended the program development meeting on May 9th, 2024.

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# Feeding and Management of Gilts and Sows During the Transition Period

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## ABSTRACT

Swine producers are currently using sow genetic lines with very high litter sizes and, even though beneficial, this creates new dilemmas in the farrowing house. The problems of longer farrowings, greater stillbirth rate, and inadequate milk and colostrum intakes by individual piglets are often encountered. More attention is now given to the crucial period of transition between late gestation and early lactation to develop the best feeding and management strategies to assist sows and their progeny. It is known that adequate dietary energy must be provided in the transition period in order to facilitate the farrowing process, decrease stillborn piglets and improve colostrum production. When time of farrowing is within 3.1 hours of the last meal, farrowing duration is minimal, and it increases thereafter. The impact of protein intake on colostrum yield is not clear, but dietary protein in the last week of gestation may impact sow milk yield and litter growth in the subsequent lactation. New feeding regimes mixing different amounts of gestation and lactation diets on a daily basis throughout transition can be used to better meet nutrient requirements. Supplementary fiber can also be beneficial to decrease constipation. Special care must be given to management strategies such as farrowing induction with prostaglandins, which should not be done too early in gestation, and the provision of an energy supplement at the onset of farrowing. Colostrum ingestion is crucial for piglet survival and by injecting a very high dose of oxytocin approximately 12 hours after the birth of the last piglet the colostral phase will be prolonged, thereby improving the quality of milk ingested by piglets in early lactation. Management of primiparous sows in early lactation must also ensure that all teats are used for at least two days after farrowing in order to maximize their productivity in the subsequent lactation.

## FEEDING IN THE TRANSITION PERIOD

### Feed intake

The transition period covers approximately the last week of gestation until a few days after farrowing. This is a crucial period when sows undergo profound metabolic changes and become catabolic because of the imbalance between intake and use of nutrients (Feyera and Theil, 2017). The energy status of sows is important for successful farrowing and Feyera et al. (2021) reported shorter farrowings with minimal farrowing assistance and a lower stillbirth rate when sows were fed 3.7 to 4.1 kg/day during the last week of gestation.

Furthermore, both inadequate and excess energy intakes negatively affected the farrowing process. Time of farrowing relative to the last meal is important as Feyera et al. (2018) demonstrated that farrowing duration was constant (3.8 ± 1.5 h) if farrowings started within 3.13 ± 0.34 h of the last meal, whereas farrowing duration increased to 9.3 h if farrowings started 8 h after the last meal. Furthermore, the rate of stillbirth started to increase when farrowings occurred more than 6 hours after the last meal. Gourley et al. (2020), however, saw no beneficial effect on farrowing duration or stillbirths of feeding ad libitum or four daily meals from day 113 of gestation until farrowing. This absence of effect was likely due to the shorter overall duration of farrowings (3.5 vs 5.8 h) and smaller litter sizes (16.0 vs 17.5) compared with the study of Feyera et al. (2018) where beneficial effects were observed. Nevertheless, pre-weaning piglet survival was greater when sows were fed four daily meals and piglet weaning weight increased in sows fed ad libitum.

An adequate supply of nutrients during transition is also important to sustain the highly accelerated mammary development and the synthesis of colostrum (Feyera and Theil, 2017). Colostrum is crucial for piglet survival and the onward health status of the animals; however, colostrum yield has proven to be very difficult to affect via nutrition. Decaluwé et al. (2014) reported that a very low feed supply (1.5 vs. 4.5 kg/d) from day 108 of gestation until farrowing tended to be detrimental to colostrum yield and caused excessive mobilization of body reserves. Feeding either a gestation (2.98 Mcal ME/kg and 5.8 g SID Lys/kg of feed) or lactation diet (3.32 Mcal ME/kg and 9.9 g SID Lys/kg of feed), Garrison et al. (2017) found a tendency for greater colostrum intake by piglets as sow feed intake increased from 1.5 to 3.0 and 4.5 kg/d from day 104 of gestation until farrowing. Feyera et al. (2021) also reported a negative effect of low feed intake on colostrum yield. First- and second-parity sows that were fed 1.8 to 5.0 kg/d (3.08 Mcal ME/kg and 8.0 g SID Lys/kg of feed) from day 108 of gestation until farrowing, showed maximal colostrum yield at 3.0 kg/d. Recent findings from Bruun et al. (2023) indicate that feed intake during the last week of gestation does have an impact on subsequent sow milk yield. These last authors compared feed intakes ranging from 1.8 to 5.0 kg/d (3.08 Mcal ME/kg and 8.0 g SID Lys/kg of feed) from day 108 of gestation until farrowing in first- and second-parity sows and showed that a transition feed supply of 4.0 to 4.1 kg/d (12.6 Mcal ME) maximized average milk yield in the subsequent lactation. These findings are most important because it is currently accepted that ad libitum feeding of primiparous sows for a prolonged period of time during gestation will reduce their lactation feed intake due to excessive body fat deposition (Revell et al., 1998). Cools et al. (2014) also showed that sows fed ad libitum during transition have a lower voluntary feed intake in the days around farrowing, without a reduction in lactation feed intake.

**Protein intake**

In the last week of gestation, approximately one fourth of the total protein content for fetal growth and mammary gland development is deposited in those tissues (NRC, 2012), and large quantities of immunoglobulins accumulate in the mammary gland to be secreted in colostrum (Feyera et al., 2019). This places an enormous demand on the protein supply to sows during transition. Garrison et al. (2017) investigated the effect of dietary composition and feed supply during transition on piglet colostrum intake. From day 107 of gestation until farrowing sows were fed 1.5, 3.0 or 4.5 kg/d of a gestation diet (SID Lys intake of 8.7 to 26.1 g/d) or a lactation diet (SID Lys intake of 14.9 to 44.6 g/d). Authors reported higher colostrum intake (129 vs 96 g) for piglets in litters from sows fed a lactation diet compared to piglets from sows fed gestation diets. Mean colostrum intake was also increased by 9 g for each 1 kg increase in feed intake. Findings indicate that insufficient dietary protein intake reduces colostrum production.

Recent results from Johannsen et al. (2024) show that dietary concentration of protein (expressed as SID Lys) in the last week of gestation has a carry-over effect on subsequent milk production. Multiparous sows with parities ranging from second to fifth were fed increasing levels of lysine (15.2 to 32.6 g/d of SID Lys) with a feed allowance of 3.8 kg/d from day 108 of gestation until 24 h after the onset of farrowing, and their milk yield was optimized with a daily SID Lys intake of 22.0 g. On the other hand, Pedersen et al. (2020) found no carry-over effect of dietary protein supply (19.2 to 28.8 g SID Lys/d) during transition on milk yield, which could be attributable to a below optimal feed supply (Bruun et al., 2023).

Taking into account the increased nutrient requirements of sows during late gestation, with energy requirements increasing by 200% and lysine requirements increasing by 300%, the gestation diet may not meet these needs. Recently, the effect of blending gestation and lactation diets during the transition period, instead of feeding a lactation diet, was studied (Gregory and Huber, 2024). Control sows were fed 2 kg of a lactation diet as of day 104 of gestation whereas treated sows were fed a daily blend of gestation and lactation diets to best meet lysine and energy requirements. After farrowing, treated sows were heavier and had more backfat than control sows, and piglet weight at weaning was not altered. These authors concluded that a transition feeding program using such a blend reduces energy mobilization by sows during late gestation while having no detrimental effect on subsequent lactation performance. It is important to mention that parity affected the dietary treatment effect, with the feed blend leading to greater body weights of piglets at birth and on day one in multiparous sows, but not in primiparous sows. In previous studies where supplementary lysine was fed from days 90 to 110 of gestation to either gilts (Farmer et al., 2022) or multiparous sows (parities 2 and 3; Farmer et al., 2023), only gilts showed increased mammary development at the end of the treatment period. Hence, gilts were more responsive to an increased nutrient supply, likely because they are still growing, and this may very well be the case during the transition period.

**Fiber intake**

Constipation is commonly seen in late-pregnant sows, and it can lead to prolonged farrowings. Dietary fibers have been used to alter the intestinal microbiota and reduce the incidence of constipation. A recent study investigated the impact of supplementing the diet of sows in the transition period (7 days before to 3 days after farrowing) with 75 g per day of lignocellulose (Dumniem et al., 2024). The fiber treatment significantly decreased the constipation rate from 46.3% to 17.6% but did not alter farrowing duration. However, treated sows with 16 or more piglets at birth did tend to have shorter farrowings than control sows (202.0 vs. 287.5 min). Colostrum intake by piglets or sow milk yield were not altered by supplementary fiber but pre-weaning mortality was reduced by 3.9% in a free-farrowing system. It therefore appears that a dietary fiber supplement during the transition period may be beneficial and this mostly in sows with large litters.

## MANAGEMENT IN THE TRANSITION PERIOD

### Late gestation

Provision of the leucine metabolite β-hydroxy β-methyl butyrate, or HMB, to pregnant sows has received attention because of its role on protein turnover. Davis et al. (2022) supplied HMB to sows in a dose-response manner (0, 5, 15, or 45 mg/kg body weight) from day 100 of gestation until parturition. Piglet birthweight and weight gains over the first 24 h and over the first week of lactation, as well as colostrum yield and intake by piglets, increased quadratically with increasing amounts of HMB. Additionally, the concentration of immunoglobulin G in colostrum increased linearly with the dose of HMB ingested by sows. These effects led to a reduced piglet pre-weaning mortality from 19.3% to 13.7% with the optimal dose of 15 mg/kg body weight of HBM.

A common practice in the farrowing house is to induce farrowings in order to facilitate supervision and cross-fostering of piglets. Farrowing induction is achieved by using synthetic forms of prostaglandin F2 alpha. When induction is done on days 113 or 114 of gestation, there is either a slight decrease (Devillers et al., 2007; Foisnet et al., 2011), or no effect (Otto et al., 2017; Boonraungrod et al., 2018) on colostrum yield. On the other hand, if induction is done on day 109 of gestation, colostrum yield is 32% lower (Milon et al., 1983). It is therefore important not to induce farrowings earlier than one day before the expected farrowing date to avoid any negative impact on colostrum yield, as well as piglet maturity. These studies were performed quite a few years ago and it is therefore very important to consider that the increased litter sizes observed in past years led to longer gestations, hence the days of farrowing induction reported earlier need to be adjusted accordingly.

### Early lactation

The injection of carbetocin (a longer acting oxytocin-like molecule) after birth of the first piglet to reduce the duration of farrowing is not recommended. Even though carbetocin reduced farrowing length from 228 to 151 minutes, colostrum yield was also decreased from 3.37 to 2.40 kg (Jiarpinitnun et al., 2019). On the other hand, one injection of a very high dose (75 IU) of the hormone oxytocin approximately 12 hours after birth of the last piglet can prolong the period of colostrogenesis (Farmer et al., 2017b). Within 8 hours of oxytocin injection, great differences in the quality of lacteal secretions were present. Milk from sows receiving oxytocin contained more proteins, immunoglobulins G and A, insulin-like growth factor-1 and energy compared to that of control sows. Oxytocin acted on mammary cells by delaying the tightening of the junctions between mammary epithelial cells and allowing passage of large molecules from the circulation to lacteal secretions for a longer period of time, thereby improving the quality of milk in early lactation.

The farrowing process is very energy demanding for the sow and feeding an energy supplement (a blend of carbohydrates and glycerol) at the onset of farrowing proved beneficial. This supplement provided 439 kJ of metabolizable energy per kilogram of metabolic weight and was associated with a shorter farrowing duration (20 minutes less) and a greater colostrum intake by piglets (Carnevale et al., 2024). However, litter growth until weaning was not altered. It can therefore be said that feeding a blend of carbohydrates and glycerol as an energy supplement at farrowing improves the farrowing process and piglet vitality score.

Growth rate of suckling piglets is dependent on milk yield, which is in turn affected by mammary development. Management of primiparous sows in early lactation can affect their milk yield in second lactation. It is known that a teat which is not suckled during lactation will undergo rapid involution. It was also demonstrated that it is essential for each teat to be used in first lactation in order for milk yield from that teat to be optimal in second lactation (Farmer et al., 2012). However, a teat can be suckled for only 2 days in parity 1 and show no reduced milk yield in second lactation (Farmer et al., 2017a). Hence, primiparous sows with very large litters can have their litter size reduced, but only on day 3 postpartum.

## CONCLUSIONS

Special care must be provided during the transition period between gestation and lactation both in terms of nutrition and management. Sows may be lacking energy and protein at this time due to rapid growth of fetal and mammary tissue, and synthesis of colostrum. New nutritional strategies, such as feeding more protein, feeding a leucine metabolite, or providing a daily blend of varying amounts of gestation and lactation diets, are being developed to best meet the changing needs of sows during this crucial period. Yet, the fact that nutrient requirements differ between primiparous and multiparous sows should be taken into account. A feed intake between 3.7 and 4.1 kg/day during the last week of gestation can decrease farrowing duration and stillbirth rate. Furthermore, farrowing duration is shorter and stillbirth rate lower when sows are provided feed in the 3.1 h preceding farrowing onset compared with 8 h before farrowing. Dietary supplementation with fiber can decrease constipation and farrowing length, and this mainly in large litters. Providing an energy supplement at the onset of farrowing can also shorten farrowing duration. Management strategies in early lactation can be used to assist the sow and her piglets. Considering the large litter size of current sow lines and the need to ensure adequate body condition for sow longevity, it is possible to remove some piglets from the udder of sows in first lactation without affecting their milk yield in the next lactation, as long as all teats have been suckled for a minimum of 2 days. In terms of colostrum yield, a single injection of a high dose of oxytocin given approximately 12 h following the end of farrowing, will prolong the colostral phase and improve the quality of milk in early lactation via increases in concentrations of immunoglobulins and growth factors.

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# Feeding the Challenged Pig

***The CFM DE LANGE Lecture***

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### Why the urgency of addressing this topic?

Without a doubt pig mortality is one of the biggest challenges the US swine industry faces today. A few years back, Knauer and Hosteler[i] (2013) reported that average mortality in the US swine industry, from 2005 and 2010, equated to 14.1, 4.9, and 6.1% during prewean, nursery, and finishing, respectively, representing over 25% mortality. To exacerbate this scenario, things have not gotten any better. In fact, according to Metafarms (2024), mortality have had a positive trajectory from 2019 to 2023, with an average annual mortality increase of 0.33, 0.17, and 0.29% during prewean, nursery, and finishing, respectively. This represents a significant inefficiency and opportunity within our systems that needs to be addressed if our industry wants to become more profitable and sustainable. To begin addressing the issue, we need to understand causation. The USDA[ii] (2015) reported that the most common causes of mortality for all phases after weaning was respiratory disease followed by scours. However, mortality causes are certainly much more complex. According to Gebhardt[iii] *et al.* (2020), who conducted an extensive review of postweaning mortality causes, identified non-infectious (i.e. environmental, season, nutritional inadequacies) and infectious (i.e. enteric disease, respiratory disease) contributing factors. Typically, there is many interactions between these factors, which make establishing mortality causes extremely difficult. Fortunately, to bring some light to the causes, work characterizing risk factors has been conducted (Magalhaes[iv] *et al.* 2022). This work has suggested that farm productivity (i.e. farrowing rate, total born) and health status (i.e. PRRS status) have a profound impact on wean-to-finish mortality. This information offers a great opportunity to forecast downstream performance, and most importantly evaluate and implement interventions strategies.

### Is weaning age relevant in the context of disease challenges?

Even though weaning age does not match within the context of this talk, I can’t stress enough about how increasing it can drastically change the way pigs cope with disease and ultimately impact mortality. Several commercial scale trials have consistently shown that increasing weaning age has a profound impact on animal performance and health all the way to market. For example, Faccin[v] *et al.* (2020a), demonstrated that increasing wean age from 19 to 28 d of age, had a reduction in pigs that lost weight during the first week post wean (35.1 to 9.2%) as well as removal rates (8.0 to 1.7%). Furthermore, pigs that require injectable antibiotics during the wean-to-market phase was reduced from 34.9 to 17.1% when age was increased from 18.5 to 24.5 d of age (Faccin[vi] *et al.* 2020b). Perhaps the lingering question is why increasing the wean age has such a profound effect? The gastrointestinal barrier serves a critical role in survival and health by providing several defense mechanisms. This barrier not only controls normal gut functions (i.e. digestion, absorption) but it provides a defense line against severe luminal conditions, which include toxins, pathogens, etc. Moeser[vii] *et al.* (2017), has demonstrated that weaning age is a major factor determining gastrointestinal barrier function. Pigs weaned at 21 versus 28 d of age, exhibit increased intestinal permeability and intestinal secretions. Conversely, increasing wean age from 21 to 28 d of age has resulted in graded reductions of intestinal permeability when measured not only at 2 weeks but 9 weeks post weaning, which might indicate that positive effects are sustained all the way to market. From a practical perspective, optimal weaning should not go over 24-25 d, because weaning over that age provides only marginal benefits. In addition, the benefits of weaning at an older age are more prevalent in poorer health status scenarios.

**What nutritional interventions have shown positive outcomes when facing disease?**

**Crude protein reduction:** This is one of the most studied nutritional interventions against enteric challenges in pigs. When piglets are fed with high crude protein (CP) diets, a significant portion of that protein will reach the large intestine, where it can be used as a substrate for bacterial growth. According to Opapeju[viii] *et al.* (2009), weaned pigs fed 17.6% CP, drastically reduced the presence of *E. coli* population in ileal digesta, before and after a challenge with *E. coli* K88, compared to pigs fed a diet with 22.5% CP diets. In addition, pigs fed the diet with 22.5% CP, reduced the villus height:crypt depth before and after the *E. coli* K88 challenge, which indicate villi atrophy, correspondent with the detection of *E. coli.* It is crucial to emphasize that although these diets are lower in CP compared to traditional formulations, they still meet amino acids requirements and support growth performance. Furthermore, pig performance may be compromised when high concentrations of feed-grade amino acids are used in diets. It has been hypothesized that the amount of nitrogen needed to synthesize non-essential amino acids may become limiting. Using nitrogen requirements suggested by the NRC[ix] (2012), the SID Lys:CP ratio should be 6.4 for pigs weighing between 11 to 25 kg. If SID Lys:CP is maintained at 6.4, when reducing CP to 20 or 18%, SID Lys would equate to 1.28 or 1.15%, respectively, which is below requirements to optimize growth performance. In this context, Cemin[x] et al. (2022) conducted a study to determine the optimal level of SID Lys for growth performance in weaned pigs from 5 to 12 kg. Experimental diets contained 1.15, 1.25, 1.35, 1.45, or 1.55% SID Lys and were fed for 21 d, followed by a common diet containing 1.30% SID Lys. Whereas pigs fed increasing SID Lys linearly improved performance during the experimental period, pigs previously fed low SID Lys improved performance during the common period, resulting in no evidence for differences in overall performance. Pigs have a remarkable ability to compensate for poorer performance in the nursery during later stages (Menegat[xi] *et al*. 2020). Feeding a low CP diet may result in a slower start, but given the appropriate time and diet formulation, in the later stages, pigs will exhibit measurable and repeatable compensatory growth response and can achieve excellent overall performance and optimize feed cost.

**Dietary acidification:** The suckling pig's main source of acidity comes from bacterial fermentation of lactose to lactic acid. Therefore, at weaning, the amount of lactic acid in the stomach is reduced due to the drastic change in diet composition (milk-based diet to a dry cereal-based diet) and remains low until 7 to 8 weeks of age. These events lead to a high stomach pH, as high as 5.0, limiting protein digestion (Stas[xii] *et al*., 2022a). In addition, increased gastric pH allows opportunistic pathogens to thrive and compromise host health (Bolduan[xiii] *et al.* 1988). Limited acidification can be attributed to the high acid-binding capacity at pH 4 (ABC-4) of feed ingredients, which is defined as the amount of acid required to lower an ingredient or diet to a stable pH of 4. Reducing dietary ABC-4 in weaned pigs' diets can maintain a low stomach pH and improve nutrient utilization. For example, Stas[xiv] et al. 2022b lowered ABC-4 in diets with and without pharmacological levels of zinc oxide (ZnO) and determined that when ZnO is not present in the diet, a low ABC-4 diet can improve gain, feed efficiency, and reduce morbidity and mortality in health-challenged nursery pigs compared to those fed a diet with a high ABC-4. Furthermore, the value of acidification has consistently shown positive results in young pig nutrition, particularly in health challenged pigs. In this context, Hart[xv] et al. 2025, suggested that feeding 0.235% of a blend of organic and inorganic acids (Acid-aid®) improved ADG, G:F, resulting in heavier BW when fed from d 0 to 16 post wean. Similarly, Faccin[xvi] et al. 2025, conducted two independent experiments and fed Acid-aid at 0.265%. In experiment 1, using Acid-aid increased ADG, ADFI, resulting in heavier final BW. Moreover, no evidence of differences were detected in G:F, mortality and removals, or full-value pigs. In Experiment 2, with lighter and health-challenged pigs, feeding Acid-aid improved ADG, ADFI, and final BW. However, feeding Acid-aid resulted in a decrease of mortality and removals, leading to an increase in full-value pigs. The magnitude of the response with health-challenged pigs was greater when Acid-aid was utilized.

**Functional additives:** Mannan oligosaccharides are refined low molecular weight carbohydrates obtained from the cell wall of *Saccharomyces cerevisiae.* Actigen® (ACT) is comprised primarily of mannose, glucose, and β-glucans (Che[xvii] *et al*., 2012a). This carbohydrate profile confers differential attributes such as marked effects on innate & acquired immunity and inhibition of bacterial attachment to the mucosal surface of gut (Spring[xviii] *et al*., 2000; Che[xix] *et al*., 2012b). Several peer-reviewed studies with nursery swine has suggested that ACT can positively impact intestinal morphology and permeability, inhibit gut colonization of enteric pathogens, and improve the pattern of immune responses with and without viral challenges. To validate some of these findings, three commercial scale experiments[xx,xxi,xxii] utilizing a total of 10,643 nursery pigs with 112 replicates per dietary treatment were conducted. During all trials, pigs were fed a modern nursery diet without antibiotics and supplemented with or without 800 ppm of ACT for the first 21-d post wean. By the end of the nursery period, mortality was reduced from 1.33 to 0.74%, which led to an improvement in full value pigs from 98.7 to 99.2%, despite lower overall mortality. Furthermore, most recently, we have also confirmed that ACT can modulate the metabolism of pathogenic bacterial cells, improving antibiotics efficacy (Grant[xxiii] et al., 2018). In fact, ACT can increase the respiration rate, induce higher reactive oxygen production, and increase extracellular acidification in antibiotic (AB) resistant and-nonresistant bacteria. When ACT is combined with antibiotics, the efficacy of the AB seems to be enhanced in a dose-dependent fashion (Smith[xxiv] et al., 2020).

**Conclusions**

Without a doubt pig mortality is one of the biggest challenges that our industry faces today. It is a complex issue that requires multi-disciplinary efforts to obtain the best possible outcomes. As nutritionists, we do have several available tools. In this context, it is critical that we understand and evaluate nutritional strategies such as crude protein levels, acidifiers, and functional additives. Additionally, management practices such as weaning age and other practices should be evaluated as well. Lastly, it is relevant to consider that each production system has a unique set of challenges, requiring a full understanding from the nutritionist to develop solutions that fit specific scenarios.

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# Unlocking the Secrets of *Streptococcus zooepidemicus*

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## Introduction

Until 2019, *Streptococcus equi* subspecies *zooepidemicus* was thought to be a commensal bacterium in swine in North America. It was not known to cause extreme impacts to hog production through significant sudden deaths and abortions. This paper will describe the extensive experience of a large commercial system with *Streptococcus equi* subspecies *zooepidemicus* (*Strep. zoo*) and provide evidence of long-term human asymptomatic carrier status and subsequent zoonotic transmission causing infection in sows. Considering this case of amphixenosis, it will discuss potential protocol changes to consider for the entire hog industry at large.

## Background

The bacterium is a β-hemolytic, Lancefield group *C. streptococcus* first isolated by P.R. Edwards in 1943. He found it was an encapsulated, gram-positive bacteria that is non-motile.[1] *Strep. zoo* is particularly well documented as an opportunistic bacterium with zoonotic potential in horses[2,3] and in other animals like dogs, cats, cattle, monkeys, sheep, goats, and chickens.[4-11] In mammals it can cause severe symptoms with pyrexia, septicemia, meningitis, and pneumonia, that often results in death.[2]

Human cases are rare but documented, usually in elderly or immunocompromised individuals that have contact with infected horses or have consumed unpasteurized dairy products or pork.[12] Prior to 2017, there were 32 recorded cases of human infections world-wide, with symptoms including rheumatic fever, kidney failure, meningitis, and arthritis.[2] To the author's knowledge, asymptomatic *Strep. zoo* human carriers infecting other mammals does not appear well studied or documented to date. Typically, the literature focuses on animal to human transfer.

The most striking characteristic observed was the speed at which adult sows succumbed to the disease. Animals would appear healthy at morning checks, but over the course of hours would develop high fevers, become lethargic and die with no other symptoms.[13] At the peak of the infections, the herd mortality exceeded 45% and abortions soared above 25%. On post-mortem: edema, lymphadenopathy and severe septicemia were common observations. Serotyping identified the strain as *ST-194*.[13] Costa's development of a type 194 specific real-time PCR enabled accurate diagnostics for both animal and environmental samplings supporting the investigations. In the sow facilities, attempts to control the disease through multiple methods failed. Lab results demonstrated the susceptibility of *Strep. zoo* to common antibiotics including tiamulin, tilmicosin, penicillin and ceftiofur. However, broad and heavy application of these antibiotics both through multiple methods did little to slow the progression of disease in the field. The hypothesis was that the infection "walled" itself off deep in fatty tissues so despite proven susceptibility in the lab, field application was unsuccessful. Antibiotics administered multiple times in six separate cases, totaling over six figures per case, produced poor results.

For the animals that survived, immunity was short-lived with no predictability on survival over the long term. Three different autogenous vaccines had no impact. Morbidity and mortality in nursery and finishing sites downstream persisted throughout the outbreaks resulting in poor growth, high mortality, and condemnation rates at the slaughter plant. In each of the cases resolution came only through complete depopulation and thorough sanitation. Later breaks in two other unrelated commercial units in Canada proved to require the same actions.

**Timeline of Infections**

In March 2019, high sudden mortality occurred in a group of replacement gilts in a multiplication grow out (Figure 1-Site A). Diagnostics indicated the presence of *Strep. zoo*. After communication with experts in various sectors of the field, the consensus was it was a commensal bacterium that should not cause widespread herd issues. The replacement gilts were moved to four commercial sites (Figure 1-Site B-E). By April 2019 animals in all sites had developed clinical symptoms and were formally diagnosed with *Strep. zoo*. Site F followed in January 2020, and at the time had no clear connection to the initial breaks.

In each case, the disease spread quickly by nose-to-nose contact. It dispersed first within pen and then between pens, until it had spread through the entire facility. In the later rebreaks, eliminating contact between pens and vigilant boot sanitation provided better control of the transmission in loose-housed barns. Site F, a stalled barn with shared water troughs, observed more rapid infection and mortality rates.

Sites A-D depopulated and underwent extensive cleaning and disinfection. This resulted in successful eradications post repopulation and the sites remain negative today. Site F depopulated and it was decommissioned. Despite strict adherence to the same protocols, Site E experienced two further re-breaks with similar severity in December 2020 and December 2022 (Figure 1).

In March of 2020, a medical professional was contracted to complete human diagnostics via bacterial cultures. This was driven out of an abundance of caution for the health of the employees. Nasal and throat swabs were collected from many employees that either worked within the positive sites or were support staff that visited those sites regularly. This included veterinarians, maintenance technicians and production management employees. All employees were negative for *Strep. zoo* on bacterial cultures.

Site E with its subsequent re-breaks became an obsession for the company. Despite extensive “tear-down” style sanitation, intense inspection, rest time for the barn, and swabbing to ensure eradication, the site broke repeatedly. Costa *et al*. demonstrated that the bacteria does not survive beyond 25 days even in a perfect environment without a live host.[16] Several papers supported that work demonstrating survival times of 1 to 3 days on the surfaces of wood, metal, and rubber in warm conditions.[14] Another study demonstrated that when substrates (wood, boots, clothing etc.) were inoculated with the bacteria, its survival was noted at 2 days in warm, dry conditions and extended to 34 days in cold, wet conditions.[15] All eradications exceeded those time periods, which should have resulted in no live bacteria remaining in the environment and therefore an exceptionally low risk of re-infection. In acts of desperation, diagnostics began on all life forms found in or around the facility including voles, mice, and small flying insects, looking for live potential hosts that might be causing the repeat infections. All returned negative PCR results.

January 2023 found us at an impasse. The barn depopulated for the third time in four years. Until the source of the breaks was identified the barn would not be repopulated. Another round of *Strep. zoo* in this facility was not possible either financially or for the mental health of the staff.

Additionally, the cause for the original break in Barn A remained unknown. This left the company feeling very vulnerable to future breaks. These factors combined to trigger a new period of intensive research, discussion, and exploring alternative approaches to solving the mystery.

**Alternate Approach**

In early 2023, an un-related large commercial site in Western Canada broke with the same strain of *Strep. zoo*. Detailed trace-outs demonstrated no points of contact between the sites described above and the new break. The system veterinarian collected and submitted large numbers of environmental samples including employee masks. The nanofiber N95 masks returned positive PCR results. However, as the barn still contained infected animals, it could not be concluded the source of the bacteria was human as opposed to originating from environmental contamination.

Fueled by this information, the exercise was repeated at Site E. By February 2023, the barn had been vacant for 8 weeks, and a full sanitation and disinfection cycle had occurred. In addition, all rodents and insects had been fully eradicated from the facility. One mask returned a positive on PCR tests for both *Strep. zoo* and more specifically for *ST-194*. While promising, it was still not possible to conclude if the bacteria on the mask was from the human wearing it or simply transferred while the employee was working in the environment.

This spawned a new hypothesis: could humans be asymptomatic carriers detectable through PCR but not through traditional cultures done in the human medical laboratories? Would human tonsil and throat swabs be positive on PCR for *Strep. zoo* and specifically *ST-194*? At the time, the PCR for *Strep. zoo* and *ST-194* was only available through the veterinary laboratory, which was not permitted to process human diagnostic samples.

In collaboration with veterinary and medical professionals, a novel approach was developed. We would collect tonsil and throat swabs from the employees. Through human medical diagnostic labs, samples would be cultured and then the bacterial DNA would then be extracted. The extracted DNA would then be sent to the veterinary lab for PCR tests for *Strep. zoo* and more specifically *ST-194*.

**Results: Laboratory Results and Investigative Findings**

While the bacterial cultures again returned negative results, the veterinary lab PCR test results were positive for S*trep. zoo* and *ST-194* on the tonsil and the throat swabs for one individual. The positive results belonged to the same employee whose mask had tested positive in the initial mask environmental test. The employee reported being completely asymptomatic for the duration of the infections.

This information culminated in a proposed scenario for the *Strep. zoo* breaks: An employee contracts *Strep. zoo* from infected sows during the initial break. The employee becomes an asymptomatic carrier of the pathogen for a prolonged period: in this case 4 years. The same human transfers the bacteria back to three separate herds causing full site disease breaks.

Based on this hypothesis, further investigation revealed the following supportive information:

A. Swine To Human Transmission:

For the duration of Site E – Break 1, Employee A participated in the removal of about 95% of the infected fallen stock. The initial break occurred in the hottest temperatures of the summer. At these temperatures, it is common for employees doing highly physical tasks to work without personal protective equipment like masks and goggles. In the heat, employees wipe perspiration from their faces with their hands and forearms. Doing so while working with infected blood and saliva could present a pathway for infection. The human mucus membranes could come in to contact with the pathogen which could then proceed to colonize the tonsils and nasal passages.

This could explain how Employee A contracted *Strep. zoo* of the same strain from positive sows during Break 1. We hypothesized the initial infection in the summer of 2019.

B. Human To Swine Transmission:

The next step was to look at the connection between Employee A and subsequent breaks. Employee A was working in each site that broke following the initial infection of the 4 farms infected directly from the gilt multiplier. Figure 2 traces the movement of Employee A during the Site E and Site F *Strep. zoo* breaks. Three means of transmission of the bacteria back to the animals were identified. First, common respiratory infections result in an increased shedding of the bacteria onto hands and surfaces by the carrier. Secondly, employees removing their masks to facilitate sneezing or spitting within the pens. Finally, wastewater from the showers and bathrooms in the offices, draining through the main manure line in the barn. Animals may be exposed to the bacteria either directly through pit overflow or indirectly through live vectors like flies.

C. Human to Human and Other Species Transmission:

As part of the disease investigation and to ensure no reservoirs for future infections, members of Employee A's family and their pets were evaluated for the bacteria. The results were negative.

## Discussion

There are 6 specific factors surrounding Employee A that made detection a reality and support the proposed scenario. There was complete stability of the staff members in Site E for more than 5 years. Employee A had never travelled outside of the province or the country at any point during their lifetime. They are not a consumer of uncooked meats or unpasteurized dairy.

Apart from the swine herds in question, the employee had no contact with other livestock. They were extremely healthy, reporting a 7-year period since the last treatment with antibiotics for any condition.

Finally, in the weeks preceding the third break in Site E, Employee A experienced significant respiratory illness, resulting in self-declared breaches in biosecurity and standard operating procedure practices. Under medical supervision, the employee completed a 21-day course of antibiotics to clear the infection. Subsequent testing at regular intervals has returned negative results demonstrating a cure to date.

Although the source of the initial break in the system has never been formally determined, Barn A had three visitors with animal contact in the weeks preceding the break – the possibility that one may have been an asymptomatic carrier remains a reasonable conclusion.

**Industry Implications**

As a result of this experience, we believe in encouraging broader discussion to share knowledge of *Strep. zoo* and its potential impacts but also to consider changes in practice that might prevent future infections. Suggestions include:

Evaluate the risks from farm employees and support staff that have regular contact with other animals that may be *Strep. zoo* carriers. This includes but is not limited to horses, assembly yards, abattoirs, dog kennels and zoos. Prohibit contact with sows by external visitors, with only extremely specific exceptions. When hiring unfamiliar staff, consider the risks and if screening or testing might be prudent.

Execute strong education campaigns on the importance of personal protective equipment when working around animals. Highlight prohibited activities (spitting in pens, sneezing without a mask around animals, poor hand hygiene, urination, and defecation in pig production areas). Consider existing employees and their practices.

Pro-actively screen employees that want to practice the consumption of uncooked meat products and unpasteurized dairy. Impose intensified travel restrictions with high-risk destinations: including downtimes and prohibited travel activities. Finally, where possible, redesign wastewater systems to isolate human waste to septic tanks.

**Conclusion**

Site E has been repopulated and is producing live healthy piglets. As of November 2024, it remains negative for *Strep. zoo*. All 15 staff from Site E remain employed, including Employee A.

The impact of *Strep. zoo* to the business has been staggering. Millions of dollars were spent on diagnostics, treatments, vaccinations, depopulation, sanitation, and repopulation. This does not include the lost opportunity cost on unborn market animals or the cost of vacant barns for extended periods of time. Additionally, the impact on the mental health of the employees should not be underestimated: this was a tough battle for all involved. *Strep. zoo*, specifically *ST-194* remains a legitimate risk to North American herds and currently prevention remains the most viable management option.

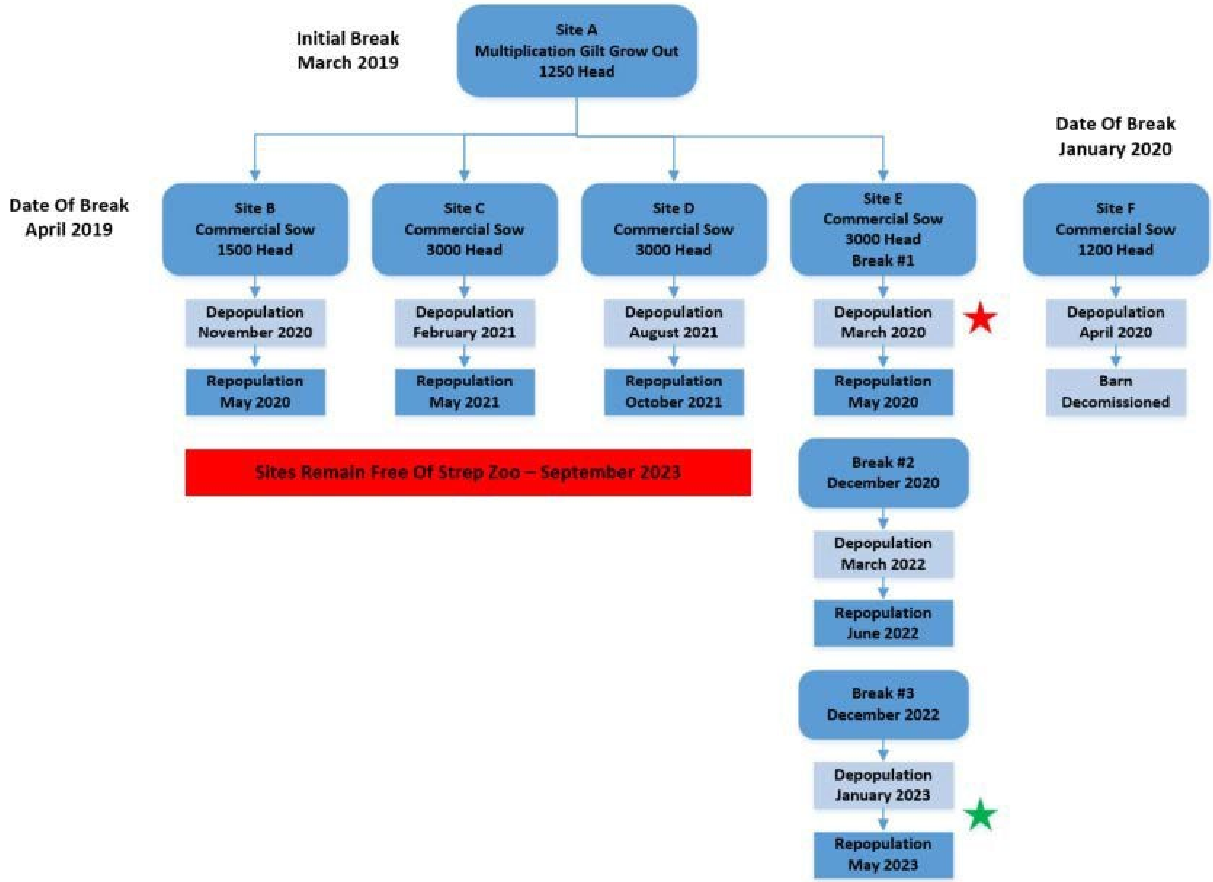


**Figure 1:** Timeline

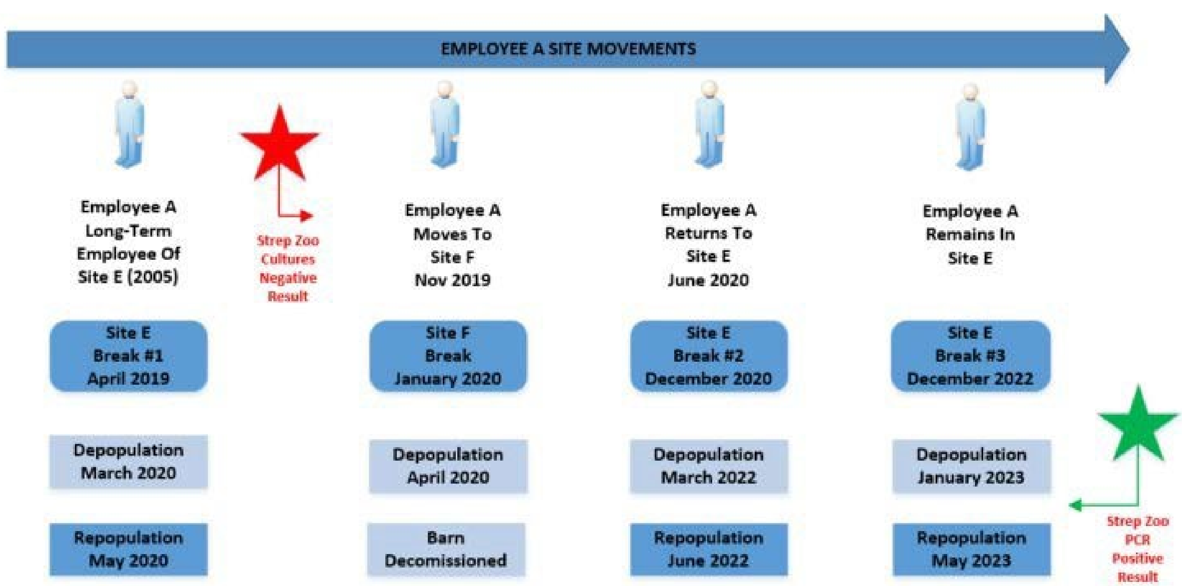


**Figure 2:** Employee Movement

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# Smart Swine: The Role of AI in Modern Pork Production

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Technological advances continue to transform the swine industry, driving improvements in efficiency, sustainability, and animal welfare. These innovations are reshaping traditional practices and creating new opportunities for growth. At the core of this transformation is Artificial Intelligence (AI), which is revolutionizing everything from feeding optimization and health monitoring to breeding programs and environmental management. AI enables producers to make data-driven decisions that enhance productivity while minimizing resource use and environmental impact.

There is no question that this field is garnering significant attention from universities, research groups, and industry members alike. But what can pork producers expect from these advancements? A few AI-driven products have already made an impact, including livestock monitoring systems, sound analysis tools, pressure-washing robots, reproductive technologies, and environmental control systems.

With ongoing investments in AI for swine production, many more systems and products are expected to enter the marketplace in the coming years. However, adopting AI does not come without challenges. High initial costs, technical expertise requirements, data management, integration with existing systems, internet connectivity issues in barns, and privacy concerns all pose potential hurdles.

While there is no crystal ball to predict which products will achieve widespread commercial adoption, the key to success will be developing systems that enhance sustainability, reduce costs, and improve overall efficiency in the industry.

# Paths to Improving Meat Quality from Farm to Fork – Swine Nutrition

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## Overview

Multiple nutritional factors have been shown to improve pork quality; however, a holistic view of the swine industry must be taken to understand strategies that are both efficient and economical. To do this, we must first define pork quality, which can vary based on the stakeholder. Yield, lean percentage, fat quality, nutritional value, and eating quality may all be the primary concerns based on whether you are a swine producer, integrated system, packing plant, or consumer. In my presentation, I hope to facilitate a discussion on successfully formulating diets with pork quality in mind while finding synergies between the quality factors most important to various stakeholders throughout the swine industry.

## Basic Nutrition Principles – Energy and Protein

Basic nutrition principles already considered in every diet formulation have the potential to significantly impact carcass quality by modulating the deposition of protein and fat. The energy value of feed ingredients and targeting a reasonable energy intake is often the first step in successful diet formulation. Enough energy is needed in the diet to facilitate maximum protein accretion, especially in an energy-dependent growth phase. However, providing an excess of energy will often lead to greater fat deposition, especially during a protein-dependent growth phase, where feed intake is not limited. In addition to energy, the second consideration in diet formulation is the protein content and amino acid ratios. Typically, the goal will be to provide enough essential amino acids and necessary nitrogen in the correct ratios to optimize lean deposition. Providing inadequate protein or having a limiting amino acid will reduce growth rate and lean deposition while also increasing fat deposition. However, with these general principles, there are often exceptions to what is actually utilized in the field. This can include feeding higher energy diets to maximize growth rate and feed efficiency despite producing a fatter carcass. Another example would be to include fibrous ingredients in the diet, such as dried distillers grains with solubles, to reduce feed costs, despite a reduction in growth performance and carcass yield. Finally, although maximum protein accretion is often targeted, protein-deficient diets have been shown to improve pork marbling at the expense of the growth rate and increased carcass fat deposition. Throughout my seminar, I will discuss the research behind these basic nutrition principles and the exceptions often utilized to reach specific production goals.

## Fat Quality

It is not only the quantity of fat that indicates overall pork quality but also the composition of that fat. Maintaining carcass fat that is firm and not discolored is important for both export markets and for processing products, such as the belly. A swine diet largely modulates the composition of fat; therefore, the inclusion of various fat sources in the diet, the types of grain sources utilized, the inclusion of fibrous ingredients, and the implementation of withdrawal strategies in the late finishing period can all influence the composition of fat. Furthermore, there is a balance in understanding pork quality associated with n-3 fatty acids between the optimal for processing pork products and what is viewed as optimal for nutritional value by the consumer. Lastly, nutritional strategies to improve the oxidative stability of fat, such as vitamin E, can be seen later in the supply chain as the products reach the consumer. Throughout my seminar, I plan to briefly touch on topics essential to maintaining fat quality while also discussing important formulation aspects to consider.

## Feed Additives

In swine nutrition, there are a plethora of feed additives, all aimed at helping the producer achieve specific goals within their production system. Feed additives with a focus on pork quality are no different. Additives including, but not limited to, vitamin E, vitamin D, vitamin C, niacin, magnesium, creatine, copper, betaine, chromium, tryptophan, selenium, quercetin, conjugated linoleic acid, and sugar have all been found to have a positive impact on pork quality. However, as commonly seen with feed additives, there are inconsistencies in the results, with other studies showing no additional benefit. A portion of my seminar will focus on discussing these various feed additives and which may elicit the most consistent responses.

## Conclusion

Multiple nutritional strategies can influence different components of pork quality, from lean deposition to fat quality. However, these strategies will only be effective if there is an economic incentive, and the strategy is easily implementable. Overall, the goal of my presentation is for attendees to gain insight into practical diet formulation strategies that specifically focus on optimizing pork quality.

# Key Factors Influencing Pork Quality – Focus on Farm Level

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## Meat Quality - Definition

Meat quality is a term that is used broadly and often describes many different meat characteristics. A common definition for quality would be "the total of all characteristics that cause differences between samples of a product and which influence the appreciation of the product by the end consumer" (Hoffman, 1994). Thus, the end user defines the quality based on preferred or valued characteristics. For pork quality, the end user can mean the processor, wholesaler, retailer, or, most importantly, the consumer. We often break this down further into 5 main categories:

1. Hygiene and food safety
    - Aspects of the slaughter, handling, and cold-chain process that could affect whether the pork is safe to eat.
2. Nutritional composition
    - Aspects of the protein, fat, and carbohydrate composition, and how that nutritional profile is perceived as healthy for the end user.
3. Ethical/welfare
    - Aspects of how the pig was treated and raised on the farm until it is processed (or slaughtered) at the processing plant.
4. Sensory
    - Aspects of the actual pork eating experience.
5. Technological
    - Aspects that can predict the eating experience or processing suitability of pork.

Of these five categories, the hygiene/ food safety, nutritional composition, and ethical/welfare components can be considered fixed aspects of quality. In other words, pork must be processed in an ethical manner and in a way that ensures safety and nutrition for consumers. Therefore, we often speak about "pork quality" in relation to sensory and technological quality. It is important to note that the ethical/welfare component has some overlap with sensory and technological components, since poor welfare results in stressed pigs and can have a negative impact on the eating quality of the pork.

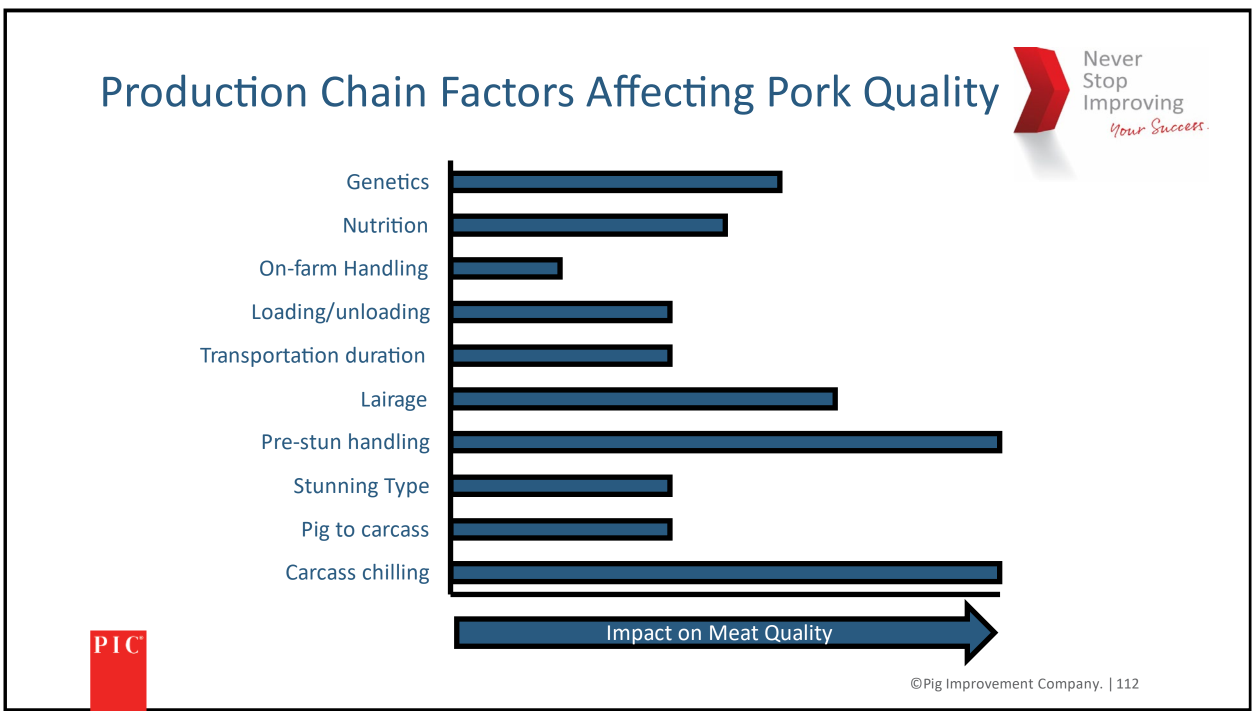
The sensory component is comprised of the assessments made during consumption of the product (either knowingly or unknowingly) that define the eating experience. Scientific testing is conducted with either a sensory (trained) or consumer (untrained) panel. Panelists typically assess tenderness, juiciness, flavor and off flavors, and degree of like/dislike. The technological component is composed of common measurements that are used to define or predict the quality of pork, including pH, water-holding capacity, color, instrumental tenderness, marbling/ intramuscular fat (IMF), and fat quality. These are the traits often used by scientists and genetics companies to compare products and make improvements. For the purposes of this paper, we will concentrate on these technological properties due to their common use in the industry and their known impact on consumer acceptance.

**The PIC Blueprint**

Thanks to our current understanding of the basic and applied science fundamentals regarding meat quality, a system can be developed to achieve desirable meat quality more consistently. The PIC Blueprint for Animal Welfare and Meat Quality, created by PIC in 1996, was one of the first industry standards for pork quality. PIC designed the Blueprint to highlight practices that ensure animals are handled and slaughtered in a humane manner, which leads to improved meat quality. PIC actively monitors and contributes to new scientific knowledge to continuously update the Blueprint. When it comes to managing lean meat quality (MQ), three main factors must be addressed: glycogen storage levels (or glycolytic potential (GP)), stress levels (S), and rate of carcass temperature (T) decline. Think of managing meat quality as an equation:

MQ=GP+S+T

The PIC Blueprint addresses10 critical areas for the development of good pork quality. These include genetics, nutrition, on-farm loading, transportation, plant unloading, lairage management, stunning management, exsanguination, stun-to-chill management, and carcass chilling.



**General Management Strategies**

Unfortunately, there is no single solution to achieving high quality product. It is the responsibility of the producer and packer to manage the environment in a way that produces the desired results and the best cost. Since the specific desired results vary from system to system, practices may vary. But the goal stays the same – a uniform, reddish-pink pork that does not drip and tastes great. Within those guidelines, there are some general rules of thumb and best practices that should be understood and managed.

1. Genetics
    a. Start with quality genetics that have the potential to achieve the desired quality.
    b. Balance the need for quantity with the desire for quality.
2. Nutrition
    a. Pigs must be fed a high-quality diet that will allow on-farm performance and not compromise pork quality.
        i. Few nutritional ingredients or practices that will consistently improve lean quality.
    b. Fat quality is almost all related to nutrition management.
    c. When possible, implement a feed withdrawal program of at least 6 hours on-farm.
3. On-farm Loading and Handling
    a. Manage weights and stocking density accordingly.
    b. Load pigs in small groups and with minimal stress.
    c. Remember that larger pigs take longer to load and plan accordingly.
4. Transportation
    a. Manage temperature during transportation as effectively as possible.
    b. Reduce transportation time as able. Avoid unnecessary stops.
5. Plant Unloading
    a. Schedule dock times ahead to prevent waiting time.
    b. Unload quickly and calmly. Avoid stressing the pigs.
6. Lairage
    a. Pigs should be rested a minimum of 2 hours to recover from transport stress.
    b. Shorter transport times require more resting time.
    c. Use proper stocking densities to ensure pigs are comfortable. All pigs should have space to lay down.
    d. Do not mix unfamiliar pigs when possible.
    e. Maintain a thermoneutral environment.
7. Stunning Management
    a. Move pigs from lairage to stun calmly and efficiently.
    b. Best to move in small, easily controlled groups.
    c. Maintain proper lighting to facilitate movements.

    d. Ensure a quick and effective stun.

8. Exsanguination
    a. Stick should be as short after stun as possible.
        i. >10 seconds for electrical stun
        ii. >60 seconds for $CO_2$ stun
    b. Ensure proper equipment and technique to remove blood quickly.
    c. Utilize “head knockers” to prevent blood clotting during the bleeding process.
9. Stun-to-chill Management
    a. Process carcasses quickly and efficiently to minimize time on the slaughter floor and begin the chilling process.
    b. Avoid “buffer rails” and rail-outs when possible.
10. Carcass Chilling
    a. Chill carcasses quickly and efficiently.
    b. Faster chilling results in better quality and improved food safety.
        i. The first 2 hours of chilling impact colour.
        ii. The first 6 hours of chilling impact water holding capacity.

**Conclusions**

By understanding the basic factors affecting product quality and designing a plan to manage them, the desired effects can be achieved in a consistent and cost-effective manner. All steps in the process must be managed and controlled as each step has the potential to negate the previous ones. Slaughter plants have a greater influence over the final product quality than live production systems, but a pig with potential for good pork quality (quality genetics, healthy, not stressed) must be delivered. Begin with the end in mind and adjust the system to best suit the final product needs while controlling costs. Integrated systems have greater control over the entire process, but independent farms and plants can achieve equivalent results when interests align. Good pork quality is in the best interest of the entire industry and efforts should be made by all parties to create the consistent and enjoyable experience for the consumer.

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# What's in a Vaccine?

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## Vaccines, what's in a label?

On every bottle of vaccine, there is a label in an exceptionally small font! However, there is a lot of information on that vaccine label – what does it mean and why does it matter?

In order for a vaccine to be approved for use in Canada, the company who makes the vaccine needs to demonstrate that it works in a laboratory setting, and that it is safe and works in a field setting. This information provided during that process determines what is found on the label. However, some vaccines are more effective than others depending on the disease the vaccine is designed to protect against. There are also many factors that will impact whether a vaccine will work in one herd and not in another. Of course, even if a vaccine works in your herd, you and your veterinarian will need to determine if it makes sense to add the vaccine to your vaccination protocols.

It is important to note that vaccines don't prevent infection – they just prevent clinical illness by giving the body the tools it needs to react quickly to a specific infection and therefore prevent clinical illness. For a vaccine to work well, it must be administered properly, the animal must be able to respond to the vaccination, and the disease challenge must not be able to overwhelm the animal's ability to respond.

## Vaccine administration

Incorrect vaccine administration will result in an ineffective vaccine! There are several possible reasons for this. If the label says the vaccine should be injected in the muscle, but the needle is too short and the vaccine just ends up in the fatty tissue under the skin, or if the vaccine label indicates it should be injected but it is mixed into water, the vaccine may not work properly. The instructions on the vaccine label will provide information including a storage temperature, whether or not the vaccine should be stored out of the light, how long the vaccine can be stored for, and if partial bottles can be stored. If any of these instructions are not followed, the vaccine may not work properly. Unfortunately, the refrigerators in some barns may be older and we find that the temperature may fluctuate, resulting in improper storage conditions and damaged vaccine. One study found that only 71% of refrigerators stayed within the recommended temperature range of 2-8 degrees Celsius, and in the summer that dropped to 43%. Sometimes the vaccine may be stored properly until the day of administration, but when multiple bottles are taken out to the part of the barn where the pigs will be vaccinated, by the time the last bottle is used it may have been over-exposed to light or exceeded the recommended temperature. Maintaining proper storage conditions until the time when the product is actually used is important! Some vaccines require mixing of the liquid and the powder portions. If this is not done in a sterile manner, the vaccine may become contaminated and ineffective. In addition, sometimes the storage requirements change once the vaccine has been mixed. The vaccine label will also provide dosing information. Although the decision may be made to use a smaller dose for economic reasons, this may impact vaccine efficacy.

**Vaccine Timing**

For growing pig vaccines, there may be a minimum age that the vaccine can be given. Passive immunity is the protection that baby pigs receive through the colostrum from the sow. This immunity helps them to fight off infection until their own immune system develops fully. However, this immunity may also interfere with these young pigs' response to the vaccine and therefore they won't develop their own immunity from the vaccine. How long the passive immunity from the sow lasts depends on the specific bacteria or virus and the amount of colostrum the piglet received, but it is often around three weeks of age. Therefore, if pigs are vaccinated when they are too young, the vaccine may not work well.

Another important aspect of timing is when the vaccine is given in relation to when the animal is exposed to the disease. There is always a time period between when a pig has been exposed to the bacteria or virus and when it starts to show signs of disease, and this time period is different for each bacteria and virus. If a vaccine is given during the period between exposure and showing signs of disease, it will not work because even though we can't see it, the animal is already developing illness, it's too late.

Even if the vaccine is given before the animal is exposed to the disease organism, it takes 2-4 weeks after vaccination for the pig to develop adequate immunity to prevent disease, and some vaccines require a booster dose for full protection. Therefore, if a vaccine is given too close to when the pig is exposed to the bacteria or virus that causes the disease, the pig hasn't had a chance to develop immunity and may still become sick with the disease. For these reasons, it is often important to work with your veterinarian to develop a testing plan, in order to really understand the timing of disease exposure in your herd.

**Did we get everybody?**

It's important that accurate records are kept of which animals have been vaccinated and when. Whether that's by using a white board in the office or a clipboard in the hallway or an app on your phone, keeping these records will help to ensure that animals aren't missed and that the pigs are being vaccinated at the correct time. There are always instances when things don't go according to plan and vaccines may be given late for many reasons. Knowing with certainty when the vaccine has been given to each group, can help to differentiate between a problem with getting the job done and a problem with the vaccine itself.

**Why do they work on my neighbour's farm but not on mine?**

Even farms with a very strong vaccine protocol on paper may struggle with disease if other pig or environmental factors are not optimal. In order for a pig to respond to the vaccine and develop immunity, it must be in good health. An animal that is compromised due to other diseases or sub-optimal nutrition may not respond well to the vaccine. Therefore, the poor-doing pigs in the pen or group, pigs that have a transient fever, or pigs that are off-feed the day the vaccine is given, may not respond well to the vaccine. Even when a pig develops good immunity after vaccination, if it is exposed to an overwhelming number of the bacteria or viruses that the vaccine is designed to protect against, it may become ill. A good analogy this winter, is that even when you have a great snowblower, if it is snowing too heavily it is impossible to keep up! This is one of the reasons that good biosecurity, all-in/all-out production, and thorough cleaning and disinfection are so important to maintaining healthy pigs. Vaccination cannot cover up poor production practices.

Some bacteria and viruses have multiple strains and whether the vaccine is effective will depend on how well the strains in the vaccine compare to the strains on your farm. PRRS, swine influenza, and *E.coli* diarrhea are common examples where differences in the strains can have a very significant impact on vaccine effectiveness. Determining the strains that are present on your farm by testing your herd as well as testing incoming animals, is an important part of determining the best vaccine strategy for you.

**Is it worth it?**

There are several factors that need to be considered when deciding if a vaccine is right for your situation. The costs of vaccinating include the cost of labour, the cost of the vaccine itself, and potentially the cost of post-injection abscesses at slaughter. Needle-free injection devices are used in Europe and are being introduced in North America. These devices remove the potential for post-injection abscesses. The cost of not vaccinating will depend on what percentage of your animals are impacted by the disease and what is the opportunity cost of that disease. Opportunity costs include both the direct costs such as mortality and the indirect disease costs such as decreased growth rate, decreased feed efficiency, delayed returns to estrus or decreased pregnancy rate.

**Why should we vaccinate if we can just treat?**

The livestock industry is under increasing scrutiny to optimize the use of antimicrobials to minimize antimicrobial resistance in pigs and in people and preserve our ability to treat infections in both pigs and in people. We have seen instances where the antibiotic that used to work well in controlling a disease is no longer effective. Bacteria cannot develop resistance to vaccines in the same way that they develop resistance to antibiotics. Therefore, effective vaccines are a strong alternative to antibiotics. In addition, if we use antibiotics when dealing with a viral infection, the antibiotics are not impacting the virus itself. They are controlling other bacteria that may cause a secondary infection. If we use a vaccine instead, the vaccine is creating a response to the virus itself and the secondary bacteria do not have an opportunity to cause disease. In addition, preventing disease through vaccination is a more positive outcome from an animal welfare perspective than treating disease when it occurs.

**Types of vaccines**

There are two types of vaccines that have been available for many years. These include modified live/ avirulent live culture vaccines and killed vaccines. Both types are found in commercial and autogenous vaccines. Commercial vaccines have demonstrated safety and efficacy. Autogenous vaccines are created using specific strains from your herd and the safety and efficacy are determined by you and your veterinarian. These vaccines can currently only be used for a certain time period, adverse events must be reported, and they can only be used on the farm where the vaccine strain was collected from. Autogenous vaccines can be very helpful for diseases where the bacteria/virus has a large number of strains and it is difficult to find a vaccine strain(s) that matches your herd.

Modified Live and Avirulent Live Culture Vaccines:

Bacteria or virus is modified in the laboratory so that it is weaker than the organism that causes disease on our farms. These vaccines produce a low-level infection and the bacteria or virus will actually replicate in the animal. As a result, modified live vaccines create a rapid and comprehensive response by the immune system and create long-lasting immunity but should not cause clinical disease. Some modified live vaccines may cause mild symptoms. Since these vaccines cause a low-level infection, some of them may not be given to pregnant animals – check the label! Modified live vaccines need to be reconstituted before being used and must be used within hours, partial bottles cannot be stored. Because these vaccines contain live organisms, they are easily inactivated by the improper storage and administration conditions mentioned earlier.

Killed Vaccines:

Bacteria or virus is killed in the laboratory but will still create immunity in the animal because proteins on its surface can still cause an immune response in the animal. Because Killed vaccines are completely inactivated, they do not replicate in the animal and are incapable of causing clinical disease. The advantages of killed vaccines are that they cannot cause disease and there isn't any risk of the vaccinated animal shedding infectious organisms. They are safe to use in pregnant animals and there is less concern about the stage of gestation at the time of vaccination. The antibodies are very specific to the strains of bacteria or virus that are in the vaccine, however it is typically easier for the vaccine company to incorporate new strains into these vaccines. A disadvantage of killed vaccines is that they usually need a booster shot which may lead to an increased cost for both product and labour.

RNA particle technology:

Vaccines that utilize RNA particle technology are essentially a sophisticated autogenous vaccine. The strains of virus that are found on your farm are utilized with the RNA platform to create a vaccine that is specific to your farm. As with a killed vaccine, these vaccines are incapable of causing illness because live virus isn't used. The RNA platform facilitates rapid vaccine development as well as faster modifications if the strains on your farm change over time.

**What's next?**

As improved laboratory techniques make it possible to identify the very specific parts of the bacteria or virus that stimulate immunity in the pig, new technologies such as DNA vaccines, mosaic vaccines and recombinant vector vaccines may become available. The increased specificity and sophistication of these vaccines should increase both safety and efficacy.

In addition, vaccines for needle-free injection devices have become widely used in Europe and may soon be introduced in North America. These vaccines avoid the risk of post-vaccination abscesses, broken needles, and employee needle-sticks. In addition, since needle-free injection devices use compressed air to administer vaccines intradermally they are painless and therefore may be of particular benefit when vaccinating sows in group housing. Over time, needle-free injection devices are becoming more streamlined and more cost-effective with respect to both initial and maintenance costs.

## TAKE-HOME MESSAGE

Vaccines are important tools in our herd health toolbox. However, in order to realize the full benefit of a vaccination program it is important that you are working with your veterinarian to ensure you are using the right vaccines, stored correctly and administered properly, to the right animals at the right time. Even when all these conditions are met, good vaccines can't cover up poor production practices and must always be considered as one part of a complete herd health plan.

# The Role of Fiber in Swine Nutrition: Benefits and Challenges

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Feed programs represent a critical investment for swine producers seeking to optimize both animal performance and economic returns. Incorporating fibrous ingredients into swine diets can provide multiple benefits beyond basic nutrition. This presentation will begin with a fundamental overview of dietary fiber - examining its definition, classification, and key functions.

Building on this foundation, we will explore the often-underestimated role of fiber in modern swine diets, highlighting how strategic implementation can enhance intestinal function, microbial diversity, behavioural well-being, and overall production. We will examine fiber's benefits and challenges, followed by a review of common fibrous feed ingredients and by-products available for swine diet formulation.

The discussion will address stage-specific considerations, exploring how fiber impacts nursery piglets, growing-finishing pigs, and sows differently.

This discussion pairs with a session on energy and protein nutrition optimization, creating a comprehensive approach to feed formulation. While our fiber-focused session explores available fibrous ingredients and strategies to maximize benefits when using fiber, the companion presentation will use mathematical modelling to determine when "more" truly delivers value versus when it simply increases costs.

# When 'More' is Good but not Always Better!
# A Practical Energy and Protein Nutrition Review

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When issues arise on farm, or performance isn't up to standard, producers and industry consultants like to suggest it could be alleviated by adding *more* to the diet. This general unspecified *more* often comes with a *more* expensive feed price. Switches between feed suppliers often occur because someone's feed costs *more* or someone added *more* specialized ingredients or *more* of one specific nutrient. If we find an ingredient that saves dollars per ton people want to add *more* and *more* and *more*. If someone grows or makes their own ingredient on farm it has to be cheaper and then we want to use *more* of it.

This breakout session will attempt to use math to determine when more is better and when more actually costs more through a review of the principles of energy and protein nutrition. For example, at times both DDGS and wheat shorts offer a savings per ton in finishing diets and it's easy to assume that if we add both and more of both, that should result in a cheaper pig to market; however, we will discuss the use of predictive feed conversion to determine if low energy ingredients are costing more per ton of meat finished. We will explore historical feed ingredient pricing to question if dietary energy levels should be more dynamic based on market conditions.

We will try to explore common on farm questions such as, is this nurse sow diet going to make more milk if it has a higher Crude fat on the tag, or how many phases of finishing feed is best, do higher amino acid premixes actually net a return?

The end goal is to formulate more like Goldilocks in search of 'just right' which might mean taking a best cost approach instead of a 'least' cost approach to put MORE money in producers' pockets.

# Gilts: The Foundation of your herd – Science into Practice

## “The Science”

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Effective gilt management practices, starting from birth, lay the foundation for future performance and are critical to improving sow lifetime productivity (SLP). SLP can be defined as the number of pigs weaned during the productive life of a sow and is influenced by key components: longevity (how long she stays in the herd), productivity (the number of pigs produced) and the efficiency in achieving these outcomes.

Sow lifetime productivity is a complex trait involving interactions between the genetic potential, the underlying physiological mechanisms and the reproductive management practices implemented on farm. Extensive research in areas such as genetics, reproduction, nutrition, health, management, technology and environment has highlighted the significant impact that good gilt management can have on future performance. However, it also highlights the complexity of the trait. While this research provides invaluable insights, a gap exists between the genetic potential (genotype) and actual outcomes (phenotype) on the farm and is largely due to differing environmental and management factors between farms. This genotype-phenotype gap presents a significant opportunity for the industry to improve SLP by effectively applying these scientific principles in their everyday practices.

This paper and its companion paper (TJ Klopp and Kendra Foran) tackle the major topic of sow lifetime productivity. Here I highlight key management strategies that will support the translation of “Science into Practice” on farm. These practices are supported by scientific research that demonstrates their critical role in optimizing gilt development and improving SLP.

### Gilt Management Practices: Foundation for Future Sow Lifetime Productivity – The Science

Focusing on the following management practices from birth onward can effectively reduce this gap and positively impact sow lifetime performance:

1. Selection and management practices at birth and weaning
2. Selection of gilts before entering the final selection phase
3. Implementing effective Gilt Development Unit (GDU) management practices
4. Achieving targets for “gilt eligibility” at first mating
5. Expanding gilt development to include “Parity 1 Development”

### Selection and Management Practices at Birth and Weaning

The selection and management of gilts start at birth and there are several important “litter of origin” traits that impact SLP:

- **Low individual birth weight (<1.0 kg):** Negatively affects piglet mortality, survival, and growth rate and has been shown to delay puberty, reduces piglet production and sow longevity (Patterson et al., 2020).
- **Colostrum intake:** Plays a vital role in promoting pig health, growth rate and survivability (Faccin et al., 2022).
- **Nursing litter size:** Strategic cross fostering of replacement females – reducing size of lactation litter – has been shown to have positive effects on overall retention rates, farrowing rates and pigs born alive (Flowers, 2022).
- **Pre-weaning growth and weaning weight** : Pre-weaning growth rate is associated with early age at puberty (Vallet et al., 2016) and positively associated with the proportion of sows that farrowed two litters and the total number of pigs produced over 4 parities (Knauer, 2016)
- **Weaning age:** Increasing weaning age by 3 days represents an increase of 0.5 pigs per sow per year (Knauer, 2016). Depending on your individual farm, it may be important to consider a wean age of 24 days for replacement females (Faccin et al., 2022).

**Selection of Gilts Before Final Selection Phase**

To start off with the best females, increase selection intensity by assessing the quality and quantity of gilts prior to entering the final selection phase (Weger, 2024).

Classify gilts as either:

- **Gilts to be culled:** Gilts not achieving a growth rate of 0.6 kg/d at ~140 days of age, or those with poor health, inadequate number of teats, poor vulva score, any defects or are unthrifty, should not be permitted to enter the final selection or
- **"Pre-Select" gilts:** Identify and select gilts based on their positive phenotypic traits such as structure, conformation and locomotion. This represents an opportunity to improve sow retention and productivity.

Always plan ahead – Recognize potential housing, environmental and management limitations to tailor the gilt flow to meet your needs.

**Gilt Development Unit (GDU) Management**

A well-managed GDU system is key to identifying gilts with the highest reproductive potential (Patterson and Foxcroft, 2019).

- **Design efficient puberty stimulation and heat detection protocols that maximize exposure to the "boar effect":** An early pubertal response (a measure of sexual precocity) is linked to better SLP and is the key driver in achieving the targets for age, weight and heat-no-serve events (HNS) at 1st mating.
- **Boar management:** Maintain a consistent supply of mature, high-libido boars for heat detection and stimulation.
- **Allocate necessary resources to the GD**U: Invest in the development and skills of the lead stockperson and provide the necessary tools and time to complete the tasks.

- **Utilize production data to make data driven decisions:** Monitor GDU performance with key production indicators.

**Gilt Eligibility at Mating**

There are four general recommendations for gilt eligibility at mating. Note that there may be slight differences in these recommendations between genetic suppliers – it is important to consult with your specific advisors for their guidance.

- **Early puberty:** Gilts should show heat by 190-200 days of age. Early puberty reduces non-productive days and improves retention and reproductive efficiency. Start boar stimulation no later than 170 days.
- **Breed gilts on at least their second detected estrus:** Breed gilts on their second detected estrus, as it improves farrowing rate, total born, retention, and lifetime performance.
- **Breed gilts between 140-160 kg body weight:** Overweight gilts (>160 kg) lead to poor farrowing outcomes, higher lameness, and lower herd retention.
- **Breed gilts before 240 days:** Delaying mating past 240 days risks breeding overweight gilts, which are less productive.

These should not be viewed as individual traits, rather, the goal is to breed as may gilts as possible that meet all these criteria. This can be referred to as the “Fertility Quadrant”. These traits can also be analogous to four tires on a well-functioning car – each tire (“trait”) is equally important for it to run well.

**Parity 1 Development**

Gilt development should extend beyond first breeding to ensure the "right" gilts are delivered to the farrowing room. To improve SLP, focus on:

- **Feed management during gestation:** Ensure gilts maintain or build body reserves without becoming over-conditioned at farrowing.
- **Body condition at farrowing:** Proper body condition impacts farrowing success, colostrum production, milk yield, and lactation performance.
- **Management during first lactation**: Provide individualized care to gilts and their litters during lactation.
- **Post-weaning management:** Address issues like failure to conceive, no heat, and lameness to reduce losses between parity 1 and 2.

**Conclusion**

This paper highlights that effective gilt management from birth through parity 1 is crucial for improving sow lifetime productivity (SLP). By focusing on key practices such as early selection, efficient GDU management, ensuring proper gilt eligibility at first mating and improve parity 1 development farms can improve SLP and reduce the genotype-phenotype gap. Supporting the translation of science into practice is critical to driving better sow retention, productivity, and overall farm efficiency.

## Disclosures

This manuscript is based on several earlier articles and presentations by the author, as cited in the references. This work is based on collaboration with a number of industry partners, including Sunhaven Farms, Sunterra Farms, The HANOR Company, Hendrix Genetics and PIC NA.


## Acknowledgements

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# Research Poster Session Abstracts

# Longitudinal Analysis of Antimicrobial Consumption in Feed for Grower-Finisher Swine in Canada

Abstract 2025-002

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Antimicrobial resistance (AMR) is an important issue for both animal and public health and is primarily driven by antimicrobial use (AMU). Considerable efforts have been placed in strategies; legislative, educational, and health management focused, aimed at reducing the use of antimicrobials in the livestock sector globally and in Canada. In parallel with such efforts, several countries developed surveillance strategies to monitor antimicrobial usage in humans and important livestock species. Pigs are documented as the highest users of antimicrobials globally, highlighting their significant contribution to overall AMU.

This study aimed to evaluate trends over time in the frequency and quantity of antimicrobial use (AMU) in feed for grower-finisher pigs using swine farm surveillance data on grower-finisher pigs from 2009 to 2022, collected by the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS).

AMU was reported several ways including the number or percentage of herds using antimicrobials, and as the number of defined daily doses for 1000 pig days at risk (nDDDvet/1,000 pig days), which adjusts AMU for different doses and durations of use. Data were analyzed through a combination of descriptive statistics, and models which investigated how the probability of using antimicrobials among all study herds developed over the study period, and how the AMU changed in herds that did use antimicrobials.

Important findings indicate an overall increase over time in the expected probability of herds not using medically important antimicrobials in feed for grower-finisher farms, with some regional variability in how patterns developed over time for specific types of antimicrobials. Moreover, at the national level, macrolides and tetracyclines showed a substantial increase in the expected probabilities of herds not using them throughout the study.

This study provides a detailed and thorough analysis of AMU trends in Canadian grower-finisher swine herds, describing how AMU in grower-finisher pig production differs regionally and has changed over time.

Ontario Swine Conference March 25-26, 2025

# Developing Targeted Treatments as Alternatives to Castration for Preventing Boar Taint

Abstract 2025-003

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Castration of male pigs raises animal welfare concerns and negatively impacts feed efficiency, the environment, and producer returns. However, it remains the most effective strategy for preventing boar taint, an off-odour in heated pork products caused by androstenone and skatole accumulation in fat. Dietary treatments have shown limited success due to the complex nature of boar taint but may work well in animals genetically predisposed to respond to a particular treatment. Our research aims to develop targeted treatment protocols to control boar taint in all animals by identifying genetic and biological markers linked to successful outcomes for different treatments.

We evaluated the effectiveness of natural products (NPs) from Chinese herbal medicine, short-chain fatty acids (SCFAs) produced in the gut from fibre-rich diets, and biochar, a carbon-based adsorbent, to reduce boar taint. Mechanistic studies using boar liver cells assessed the ability of NPs and SCFAs to increase androstenone and skatole breakdown, promoting excretion. Animal trials evaluated the effect of a 5% biochar diet on fat androstenone levels over a 4-week treatment and 2-week recovery period.

Several NPs, including diallyl sulfide (garlic), ginkgolide A (*Ginkgo biloba*), (Z)-guggulsterone (guggul), and oleanolic acid (olives), along with SCFAs acetate, propionate, and butyrate, significantly increased androstenone and skatole breakdown in liver cells. Future studies will assess their effectiveness in reducing boar taint in animal trials with diets containing NPs or fermentable carbohydrates. Dietary biochar treatment reduced fat androstenone in a subset of animals, with levels rebounding after biochar removal during recovery. Additional subgroups included animals that did not respond to treatment or never developed boar taint. We plan to use genotyping and microbiome sequencing of these animals to identify markers that can predict individuals that respond to treatment and those that do not develop boar taint. This approach hopes to replace castration for controlling boar taint.

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# Evaluation of Risk Factors Affecting Sow Liveability in Ontario Swine Farms

Abstract 2025-004

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Sow liveability, or the ability to keep sows healthy and productive in the herd, is an important aspect of commercial swine production. In Ontario, commercial swine farms are facing a common problem with sow liveability, as more sows are being removed early from the herds. These early removals result in financial losses and raise important questions about the underlying causes influencing this trend.

There are many reasons for sow removal, including old age, reproductive performance, and diseases. Early removal, however, can be caused by a single causative agent, such as a bacterial or viral infection, or result from a combination of multiple risk factors that may act independently or interact with one another. Understanding these factors is critical for developing strategies to improve sow liveability and reduce unnecessary early sow removal.

This study, initiated through collaborations with industry partners, investigates the association between sow and herd-level risk factors and sow liveability on Ontario swine farms. Using existing data, the study analyzes historical trends in sow removals and associated risk factors. Key factors related to sow health, such as reproduction, productivity, locomotion, parity, body condition, and seasonality, will be evaluated. By analyzing these data, the study aims to identify key risk factors affecting sow liveability, along with trends such as changes in mortality rates over time and temporal patterns that influence these risk factors.

This work will contribute to a deeper understanding of the risk factors influencing sow removals in Ontario swine farms. Additionally, the findings from this research will advise producers and veterinarians with evidence-based recommendations to improve sow liveability and enhance herd productivity.

# Increasing Standardized Ileal Digestible Methionine Intake in Gestating Gilts Improves Nitrogen Retention.

Abstract 2025-005

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Dietary methionine required to optimize whole-body nitrogen retention of gilts during gestation may be relatively greater than current feeding recommendations, due to greater productivity of modern genetics. Indeed, the current methionine feeding recommendations were generated using data from 70 years ago, when reproductive performance was much less than current standards. Therefore, the objective of the present study was to evaluate the level of methionine necessary to maximize whole-body nitrogen retention by gilts in late gestation.

A total of 70 gestating gilts were fed one of seven diets with standardized ileal digestible (SID) methionine ranging between 50 and 150% of estimated requirements during late gestation. The experimental diets provided excess Cys and 2.6, 3.4, 4.4, 5.2, 6.0, 7.1, and 7.8 g SID methionine/day, respectively, with a feed allowance of 2.61 kg/d. Diets were fed to individual gilts for a seven-day adaptation period followed by a nitrogen balance period between gestation days 109 and 112.

Total nitrogen excretion decreased and whole-body nitrogen retention (protein deposition) increased with increasing dietary SID methionine content. Whole-body nitrogen retention (protein deposition) was optimized at 6.0 g SID methionine per day, which is 15% above the current recommendation.

Providing insufficient dietary methionine can force the gilt to mobilize maternal protein to support fetal growth, which could have negative carry-over effects on subsequent lactation and reproductive performance. Therefore, to maximize whole-body nitrogen retention (protein deposition) of gilts in late gestation under current production conditions, SID methionine intake should be increased 15 to 20% of the current recommendations.

# Comparing Methods of Injection for Iron Administration: Needle-Free Device vs Needle-Syringe

Abstract 2025-006

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Iron supplementation is a routine and necessary procedure to prevent iron deficiency anemia in piglets, typically administered through intramuscular injection by a refillable needle-syringe device. Needle-free injection devices (NFID) were introduced into agriculture as an alternative to needle-syringe devices for vaccines, antibiotics, and iron injections, and are acceptable for use under the Canadian Pork Excellence PigSAFE/PigCARE Program. Recent research shows NFIDs to decrease overall processing time in nursery and grower operations, prevent the spread of infectious disease between pigs and reduce needle-stick injuries, however, NFID technology has not been implemented industry wide.

This study looks to compare welfare indicators and total processing time of iron supplementation in nursery piglets when administered by intramuscular injection from single needle use, repeated needle use, or by NFID.

A total of 1080 piglets from 108 litters (10 piglets per litter) were randomly assigned to one of three treatment groups at 3-4 days of age for a standard injection of 1ml (200mg/ml) iron dextran: (1) NFID, (2) single needle used repeatedly for 10 pigs, (3) single needle for each pig (10x). Piglet retreat attempts and piglet vocalizations at the time of injection were recorded to measure behavioural indicators of pain. Total time of administration was also recorded to compare the effectiveness of NFID to needle-syringe in an on-farm setting.

Data analysis is still in progress and will include comparisons of vocalizations and retreat behaviours. The results of this study have the ability to inform on-farm practices of alternative injection methods and highlight the importance of revisiting common husbandry procedures.

# Comparing qPCR vs Autofluorescence Technique in the Diagnosis of *Cystoisospora suis.*

Abstract 2025-007

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Cystoisosporosis, caused by the parasite *Cystoisospora suis* (*C. suis*) is ingested orally from the environment and invades the intestinal lining, resulting in diarrhea and stunted growth in piglets. Autofluorescence (AF) microscopy is a sampling technique that works by the detection of ultraviolet excitation emitted from the oocytes from fecal smears. Recently, a new sampling method (qPCR diagnostic test) that detects all stages of *C. suis* has been developed. Both these techniques have a higher sensitivity than flotation in the detection and quantification of *C. suis*.  This study aims to compare both diagnostic techniques: qPCR test vs AF microscopy in piglets treated with a new injectable combination of toltrazuril and iron for parenteral application (Forceris®) (Group F) vs piglets with only injectable iron (Group C).

In a clinically affected farm (400 sows), two diagnostic techniques were used to detect *Cystoisospora suis* infection in pre-weaning piglets. Litters were randomly selected and assigned to one of two groups: 12 litters (141 piglets) were injected with Forceris® at 1-3 day of age (doa) (Group F); and 12 litters (141 piglets) received only iron at 1-3 doa (Group C). Fecal samples were collected at 10-12 doa and 18-21 doa. Pooled fecal samples to detect *C. suis* were then sent to two different laboratories for qPCR and AF testing.

Sensitivity is a key for veterinary practitioners in the detection, diagnostics and control of cystoisosporosis in affected farms. After confirming the efficacy of Forceris® with qPCR technique and AF testing, the level of agreement between both tests was estimated with Cohen's Kappa (K). In conclusion, there is a substantial agreement between both a direct visualization of parasite final stage-oocysts with the autofluorescence technique and detection of parasite DNA via qPCR method.

# Comparing Pharmacokinetics of Meloxicam When Administered with a Needle-Free Injection Device vs. a Needle-and-Syringe in Piglets

Abstract 2025-008

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Piglet castration at any age requires analgesics, according to the Canadian Code of Practice. Meloxicam is a labeled analgesic for castration in pigs. Needle-free injection devices (NFIDs) are permitted for use in Canada, and their uptake of NFIDs has the potential to optimize animal welfare and husbandry while also reducing the risk of needle-stick injuries. The objective of this study was to compare the pharmacokinetics (PK) of meloxicam by intramuscular injection using a needle-and-syringe (NS) versus a NFID in piglets.

Seven-day-old commercial piglets (N = 26) were randomly assigned to one of two treatment groups, receiving the same labeled dosage of 0.4 mg/kg of meloxicam. The NFID treatment was administered using the Pulse© 50 (Pulse NeedleFree Systems, Inc., Kansas, USA), while the NS treatment was administered intramuscularly (IM) with a 20G x 1" needle and a 1 mL syringe. Blood samples were collected at 15 time points out to 72 hrs post treatment through surgically indwelling jugular catheters. Plasma meloxicam concentrations were measured using liquid chromatography-tandem mass spectrometry.

The results indicated significantly lower maximum concentration ($C_{max}$) and area under the curve ($AUC_{0-\infty}$) for the NFID group compared to NS group ($P < 0.001$). The ratio (%) of NFID/NS for $C_{max}$ was 39.7 (90% CI: 34.8 - 45.2) and for $AUC_{0-\infty}$ was 30.3 (90% CI: 23.3 - 39.4) on log scale. As $C_{max}$ and AUC reflect the rate and extent of drug exposure, these results suggest the two injection methods did not achieve bioequivalence. Importantly, the efficacy of NSAIDs (e.g., meloxicam) depends more on the drug concentration at the site of inflammation, and plasma concentration is not well correlated with the concentration at the inflammation site. Therefore, the appropriateness of using an NFID to deliver meloxicam in nursing piglets requires further investigation.

# Efficacy of Iron Dextran Administration Via Needle-Free Injection Versus Needle-and-Syringe Injection in Nursing Piglets

Abstract 2025-009

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Piglets require exogenous iron supplementation within their first week of life to prevent iron deficiency and anemia. Administering iron supplements is a routine part of piglet processing in commercial barns. While needle-free injection devices (NFIDs) are approved for use in Canada, their implementation for administering iron dextran has not been fully explored. This study aimed to compare hemoglobin concentration after injection by NFID and needle-and-syringe and to evaluate the efficacy of the administration in preventing iron deficiency and anemia in nursing pigs.

Seventy-six commercial piglets (3.6 days old, 2.1 kg) were randomly allocated to one of two treatment groups, with both receiving the labeled dose of iron dextran. The NFID treatment was administered using the Pulse© 250 (Pulse NeedleFree Systems, Inc., Kansas, USA), while the intramuscular (IM) injection in the NS treatment group was given using a 20G × 1/2" needle and a 3 mL syringe. Whole blood samples were collected from the same piglets before administration of iron dextran and at weaning. Complete blood count analysis was performed by the Animal Health Laboratory (University of Guelph).

The preliminary analysis showed a significant difference in hemoglobin concentration between the two groups at weaning ($P$ = 0.001). Hemoglobin (g/L)±$SD$ was 114.1±8.9 in the NFID group and 120.7±8.0 in the NS group. However, the mean hemoglobin level in the NFID group was significantly higher than the 110 g/L cut-off for iron deficiency (P = 0.004). The results suggest that, while there is a statistical difference, it may not be a biological difference between the two groups. Analysis of other parameters and the final model for hemoglobin concentration at weaning are pending and will be performed using a mixed linear model.

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# Real-time Antimicrobial Resistance Displays in Veterinary and Human Medicine: A Scoping Review

Abstract 2025-010

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Antimicrobial resistance (AMR) was identified as a top global health threat to humans and animals by the World Health Organization and the World Organization for Animal Health. Antimicrobials are used at all swine production stages in commercial farms in Ontario and elsewhere, and AMR development in swine can impact treatment outcomes. The use of antimicrobials in livestock is a contributing factor to AMR worldwide. To better understand AMR, data should be disseminated promptly to support informed decisions by data end-users, including veterinarians and producers. This could be addressed through real-time display of results to help end users understand and monitor AMR. A scoping review was conducted to understand the current literature surrounding real-time AMR visualizations.

Key data sources were searched for relevant publications. Citations were screened for four main criteria: the text had to be available in English, published after 1989, include AMR display methodology or approaches, and include an AMR display that had to be updated at least quarterly. After screening, data charting was performed to capture key details from each publication. Screening and data charting were performed by two reviewers in Distiller-SR.

Forty-two publications with over 40 unique data sources were identified as relevant and included in data charting. Various bacterial genera and species were used; we found the most common bacteria, when specified in displays, were *Escherichia coli* and *Staphylococcus aureus*. Thirty-two displays focused on human data; however, some focused on animals (n = 2) or both humans and animals (n = 8). Most of the displays were designed for in-hospital use by healthcare professionals in a primary care organization.

AMR data visualization is an essential component of continued AMR surveillance and is often part of a larger surveillance system. Continued improvement on the development of AMR data visualizations from animal health data should be considered.

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# *E. coli* Pathotypes and Genetic Susceptibility to *E. coli* in Diarrheic and Healthy Pigs

Abstract 2025-011

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Post-weaning diarrhea (PWD), with enterotoxigenic *Escherichia coli* (ETEC) as one of the leading causes, is one of the most important diseases in the swine industry. The objectives of this study were to determine virulence factor genes in *E. coli* isolates recovered from diarrheic and healthy post-weaning pigs, and to examine host genetic susceptibility to *E. coli* infection.

Rectal swabs and blood were collected from 5 healthy and 10 diarrheic pigs on each of 20 Ontario farms. Fecal swabs were cultured for *E. coli*, and the isolates genotyped. The blood samples were used to test pigs for polymorphisms in *MUC4*, *FUT1* and the CHCF1 marker.

Overall, *E. coli*-F4 was recovered from 9.0 % (10.5 % diarrheic and 6.0 % healthy) pigs on 8 farms, while *E. coli*-F18 was recovered from 8.0 % (9.0 % diarrheic and 7.0 % healthy) pigs on 5 farms. The genes responsible for LT, STa, STb, and EAST1 were detected in 24.3, 10.3, 24.7, and 35.7 % isolates, respectively. The most prevalent *E. coli* pathotypes were i) *E. coli* F4: STb:STa:Paa and ii) *E. coli* AIDA-I:LT:STb:EAST1. In total, 42.7 and 56.3 % of pigs were susceptible to *E. coli*-F4 based on *MUC4* and CHCF1 markers, respectively, while 93.7 % pigs tested were susceptible to *E. coli*-F18 based on *FUT1*.

It is possible that diarrhea was caused by other microbial agents, and a more thorough analysis of microbiome would help identify those agents. The isolation of virulent *E. coli* from pigs without diarrhea indicate that those pigs could be a healthy carrier and/or might have developed diarrhea later. These findings can be used to develop an effective *E. coli* vaccine that targets the most common *E. coli* pathotypes on Ontario swine farms. The prevalent susceptibility to *E. coli*-F18 may suggest a long-term program to breed resistant pigs.

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# Surveillance of PCV2d in Ontario herds

Abstract 2025-012

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Porcine circovirus associated disease (PCVAD) results in weight loss, respiratory issues, reproductive failure, and high mortality rate especially in young pigs. Efficacious vaccination programs have existed for many years, but recently there has been an increase in the number of cases with PCVAD in commercial herds using an efficacious vaccination program. When further investigation is done, there are often co-infections with PRRS or other infectious agents which allow for PCVAD to occur. As a result, to better understand PCVAD, a case definition was implemented to allow for further investigation. Herds with clinical signs and presence of lung lesions that also submitted blood or tissue samples for PCV 1/2/3 PCR and histopathology/IHC testing for PCV2. If the samples were PCR and IHC positive for PCV2, they were sequenced and included into a database. Specifically, herds with PVC2d sequences have been investigated as more severe clinical signs were observed in these cases. Cases that met definition were sequenced retrospectively and added to the database. Beginning in 2019 to present, a total of 37 cases were sequenced. In all years except 2021, PCV2d was the majority and in recent years the proportion of PCV2d sequences have increased. PCV2a was the second-most sequenced strain. The majority of cases occur in nursery (51%) and finishing (46%). PRRS was a co-infection in 89% of sequences for PCV2a, b, and d. As PCV2 continues to evolve, continued monitoring and sequencing are important to help understand changes in clinical presentation.

# PRRS Prevalence, Production Outcomes, and Intervention Strategies in Ontario

Abstract 2025-013

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Porcine reproductive and respiratory syndrome (PRRS) is a production-limiting disease with global impact. Although regional differences exist, monitoring disease dynamics and management approaches is important in understanding PRRS changes over time, and ultimately, optimal control strategies. A surveillance program was established at a swine-focused veterinary practice in Ontario to monitor and evaluate PRRS outbreaks and their intervention strategies. Sow herds are enrolled into the program upon exhibiting clinical signs of PRRS infection, with subsequent sequencing. Dedicated staff conduct surveys with veterinarians to gather insights on demographics, clinical severity, genetic sequencing, co-infections, outbreak history, biosecurity, farrowing schedule, suspected infection route, and mitigation strategies (e.g. elimination/stabilization, vaccination/serum inoculation). Timelines are created for veterinarians and producers, establishing dates and procedures to be implemented on-farm, reviewed quarterly. Standardized performance and diagnostic data are databased and categorized into pre-break baseline, PRRS break, post-break variability and post-break baseline periods, allowing for annual evaluation of intervention strategies across strains and years. By using this surveillance model, 71% (n=113) of sow herd outbreaks have been monitored since 2021. A higher proportion of herds applied stabilization interventions in 2024 (59%) versus 2023 (35%), likely due to prolonged time to negative and frequency of reinfection. As the annual number of outbreak sequences has increased since 2021, the ongoing evaluation of production outcomes by strain and/or intervention has become vital. Implementing a surveillance program facilitates continuous learning and understanding of endemic disease trends and identifying effective mitigation strategies within a clinical practice. This program demonstrates that veterinary practices can successfully implement surveillance systems, often providing detailed and specific data not possible to obtain through broader initiatives.

# Gilt Late Gestation Dietary Lysine (Protein) Requirements are Greater than Current Estimates

Abstract 2025-014

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Modern sows cannot produce enough milk to maximize pre-weaning piglet growth rates. Previous studies indicate increased lysine (protein) intake by gilts in late gestation improves mammary development and fetal weights. The objective of this study was to determine the lysine (protein) intake of gilts needed in late gestation to maximize N retention, N retention efficiency, piglet birth weight, and subsequent milk production. On d 90 of gestation, 152 gilts were assigned to one of seven isoenergetic diets that provided equally spaced and increasing standardized ileal digestible (SID) lysine levels that ranged from 70 to 160% (13.3 to 30.5 g SID lysine per day) of current estimated requirements. Soybean meal was used to increase lysine (protein) supply. Diets were provided until farrowing. Thereafter, all gilts received a common lactation diet. Gilt body weight gain in late gestation and body weight loss in the subsequent lactation period increased with increasing lysine (protein) intake (linear; $P<0.001$ and $P=0.086$, respectively). Nitrogen retention increased with increasing lysine (protein) intake (linear; $P<0.001$) and was maximized at 22.0 g SID lysine/d (115% of current requirement). Nitrogen retention efficiency increased then decreased with increasing lysine (protein) intake (quadratic; $P<0.05$) and was maximized at 23.0 g SID lysine/d (120% of current requirement). Piglet birth weight increased then decreased with increasing lysine (protein) intake (quadratic; $P<0.01$) and was maximized at 22.0 g SID lysine/d (115% of current requirement). Overall litter average daily gain and estimated milk yield increased with lysine (protein) intake in late gestation (linear; $P=0.057$ and $P<0.05$, respectively). Milk yield was maximized at 23.0 g SID lysine/d (120% of current requirement). Therefore, SID lysine intake in late gestation should be 22 g/d to maximize piglet birth weight and N retention, and 23 g/d to maximize N retention efficiency and milk yield, which are greater than current recommendations.

# Risk Assessment of Zoonotic HPAI A(H5N1) Transmission: Framework from a Dairy Herd

Abstract 2025-015

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Highly pathogenic avian influenza (HPAI) is a threat to livestock operations. An outbreak of HPAI can lead to trade restrictions, reduced animal product consumption, and the need for culling. In addition to economic and animal welfare concerns, there is a risk of zoonotic transmission. The risk of infection increases for agricultural workers who are more likely to be exposed. HPAI A (H5N1) was confirmed in the USA in March of 2024 in dairy cows. In October of 2024, there was one confirmed case in a backyard pig herd. Sporadic transmission between dairy cows and humans has also been confirmed. To better understand the probability of infection in humans, a quantitative risk assessment model was developed to estimate the probability of transmission from dairy cows to agricultural workers.

The model will assess exposure based on putative risk factors, especially contact with raw milk during milking or feeding calves. Additionally, it will explore herd prevalence, viral load in the exposure pathways, and preventative measures taken by workers with other factors to calculate the probability of infection. Our inputs will be drawn from the literature and expert consultation. The model will be implemented using ModelRisk, an Excel add-on for risk assessment.

Quantifying the probability of infection to agricultural workers could help inform decision making within the farm operation and surveillance. The framework of this model could be useful for models in other livestock sectors. The case of H5N1 detection in a backyard pig herd in the USA underlines the need for monitoring and consideration of risk to commercial herds and subsequently agricultural workers. This framework, if applied to swine, could contribute to the current understanding of the probability of human infection by different influenza A viruses on a swine farm.

# Enhancing Canola Meal through Bacterial Fermentation for Swine Nutrition

Abstract 2025-016

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Canola meal is a valuable protein source for monogastric animals; however, its inclusion in their diets is limited due to its high dietary fibre content and the presence of phytic acids. These factors can negatively impact feed efficiency and animal performance. The study aims to evaluate the effects of fermentation induced by the two probiotic bacterial strains on enhancing the nutritional value of canola meal.

Fermentation was performed using two probiotic *Bacillus* strains, BS9 and L5, over 48 hours, followed by samples collected and dried at 60°C for 72 hours. Post-fermentation analysis revealed significant reductions in phytic acid concentrations in both BS9 treatment ($P < 0.01$) and L5 treatment ($P < 0.01$). Neutral detergent fibre (NDF) also decreased significantly in the BS9 treatment ($P < 0.01$) and L5 treatment ($P < 0.01$). Additionally, soluble protein increased significantly, from 127.9 g/kg to 261.2g/kg in the BS9 treatment ($P < 0.01$) and to 237.06 g/kg in the L5 treatment ($P < 0.01$). These results indicate that fermentation reduced anti-nutritional factors and has the potential to improve protein digestibility.

An animal trial is currently underway to assess the efficacy of fermented canola meal *in vivo*. Ninety-six early-weaned piglets were randomly assigned to one of four dietary treatments, with six replicates per treatment and four pigs per pen. The treatments consist of a positive control, a BS9-fermented canola meal, an L5-fermented canola meal, and a negative control containing an intact canola meal. Both intact and fermented canola meals were included at 15% in the experimental diets. Pigs are fed their respective diets for four weeks, with body weight and feed intake recorded weekly.

Our study aims to provide insights into the potential of fermentation to transform canola meal into a more digestible and nutritionally valuable feed ingredient.

# The Antiviral Potential of a Newly Isolated Probiotic AJ3

Abstract 2025-017

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Viral diseases such as the porcine reproductive and respiratory syndrome virus (PRRSV) and influenza continue to challenge swine health, reduce productivity, and impact global food security. The rapid mutation rates of viruses can limit vaccine effectiveness, highlighting the need for alternative or complementary biosecurity strategies. Probiotics are known to enhance gut health, modulate immune responses, and inhibit pathogen colonization. Recent evidence suggests certain probiotics may also possess antiviral properties.

In this study, a probiotic strain isolated from environmental sources, *Leuconostoc mesenteroides* (AJ3) was evaluated for its antiviral effects. A combination of in vitro assays using porcine intestinal epithelial (IPEC-J2) cells and embryonated chicken eggs were utilized as a model to assess AJ3's ability to reduce influenza viral titers. Time-of-addition experiments revealed that treating viral particles with probiotics or their secretions before exposure to host cells led to the most significant reductions in viral titers. This suggests a direct virustatic effect or interference with viral adsorption. Additionally, AJ3 treatment notably improved survival rates in virus-inoculated embryos and reduced viral concentrations in the allantoic fluid, indicating protective effects beyond the cellular level.

These results suggest that AJ3 may offer dual antiviral benefits—direct inhibition of viral replication and enhancement of host defenses. Their application as a biosecurity measure could provide swine producers with a natural, scalable solution to mitigate viral infections. Future research will identify the specific antiviral compounds produced and optimize probiotic integration into swine health management protocols.

# Correction of Systematic Bias for Pig Measurements Using a Minimal Sample Size

Abstract 2025-018

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The swine industry often uses estimated linear body measurements (LBMs) and body weights (BWs) to assess swine conditions efficiently. LBMs can be derived from digital images, and used in published BW estimation models, but these models can introduce significant systematic biases due to factors like animal positioning, motions, camera settings, and herd-specific model biases. This study introduces a bias correction approach that automatically identifies the optimal correction method and determines the minimum required sample size for manual measurements to achieve accurate bias adjustment.

In this study, 26 pigs were manually measured for body length (BL), abdominal diameter (AD) and BW at 50, 80, and 100 days of age. Digital images were used to estimate BL and AD, with measurements averaged from two annotators. AD was converted to heart girth (HG) assuming a circular circumference. The pigs were divided into two groups: the reference population for deriving bias correction parameters, and the testing population for applying them. A software tool was developed to automatically select the most effective bias correction method from combinations of Regression of Observed on Estimated Values (ROE), Quantile Mapping (QM), Power Transformation (PT) with Equalization of Mean and Standard Deviation (EMS), and Equalization of Peak to Peak (EPP). The minimum sample size required for effective bias correction was experimentally determined by comparing corrections that leverage the entire reference population, the minimum sample size, and uncorrected measurements.

The study found that bias correction significantly improved estimation accuracy, with up to 1043% in Concordance Correlation Coefficient, and a 93% reduction in Root Mean Squared Error, while maintaining linear correlation and variability. Importantly, only 28.6% of the population needed manual measurements for effective bias correction. These results indicate that labour-intensive manual measurements can be minimized and replaced by bias-corrected estimations, demonstrating the proposed software's potential to improve swine farming efficiency.

Ontario Swine Conference March 25-26, 2025

# Investigating the Effect of Non-Steroidal Anti-Inflammatory Drugs Administered to Sows During or Immediately After Farrowing on Sow Performance and Piglet Viability

Abstract 2025-019

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The importance of management practices to mitigate the physiological stress of farrowing is beneficial for both the well-being of the sow and litter, as well as for production efficiency. This randomized controlled trial examines whether non-steroidal anti-inflammatory drugs (NSAIDs) given to sows during farrowing or immediately following farrowing is associated with better sow and piglet performance.

In this study, 455 sows were stratified by parity and randomly allocated to 1 of 3 treatment groups: meloxicam (2.5 mL per 100 kg body weight), saline (2.5 mL per 100 kg body weight), or ketoprofen (3 mL per 100 kg body weight). Observations from both sows and their piglets (n= 6211) were collected over 3 time points: late gestation, parturition and lactation, and 2-weeks post-farrowing. As sows moved from gestation housing to farrowing crates, sows were weighed and backfat was measured. Litter size (number of born alive and stillborn piglets), piglet birth weight, pre-wean deaths, and farrowing duration was recorded during the parturition and lactation stage. Both sows and piglets were weighed 2-weeks post-farrowing, and sow backfat was measured.

The findings revealed that the administration of NSAIDs did not improve pre-wean mortality, and sow weight and backfat recovery 2-weeks post-farrowing. Further, there was no benefit in the use of NSAIDs on sows that experienced difficult farrow (>1 stillborn). Although, NSAIDs administered during farrowing did not increase the likelihood of a stillborn piglet; however, resulted in a significant increase in duration.

The trial demonstrated that the use of NSAIDs did not improve piglet survivability and reproductive performance. However, the trial illustrates that administration should be refrained until after sows have completed farrowing.

# Hybrid Deep Learning Approach for Automatic Detection of Mounting Behavior in Boars

Abstract 2025-020

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Mounting behaviour in group-housed pigs raises welfare and productivity concerns, including increased stress, injuries, and potential lameness. This study presents a novel hybrid deep learning system that automatically detects mounting behaviour in boars using video footage. By combining a deep learning approach for boar recognition with an intelligent classifier, the system improves boar detection and behaviour identification while handling occlusions and complex interactions among animals. The system was trained and tested on video data from two groups of four boars, aged 4-5 months, using 766 two-second video clips with a balanced class distribution.

The system achieved 95% accuracy on a testing set with 139 clips, outperforming existing methods, especially during mounting events with significant pig overlaps. The system processes videos at 5 frames per second, allowing real-time monitoring while accommodating any input size and frame rate. The system is fully automated and requires no manual input for operation, reducing labour-associated needs and costs.

This can improve animal welfare by allowing early detection and intervention in mounting events, reducing injuries and stress, and assisting with selection for genetic improvements. However, challenges remain in generalizing the model to new commercial settings, with partial re- training as a potential solution. Future research will focus on scalability, commercial applications in swine production systems, and integrating individual pig tracking. This study advances precision livestock farming by providing an efficient tool for continuous monitoring of animal behaviour, promising significant improvements for both animal welfare and production efficiency.

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# Pheromonal Synchronization of Estrus in Replacement Gilts

Abstract 2025-021

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In breeding sows, pheromonal synchronization of estrus is preferred over the boar effect as it eliminates the need for boar housing and handling, thereby reducing logistical, safety-related, and epidemiological challenges, while still providing satisfactory reproductive results. The main objective of the present study was to evaluate the effects of Boarbetter® (a patented compound pheromone preparation) on the reproductive performance of replacement gilts in a commercial setting and to compare them with those obtained using the boar effect.

Crossbred gilts (Danish Yorkshire´Danish Landrace) aged 22 weeks were purchased and arrived at the farm in November, December, January, and March (four study replicates; n=156-167 gilts per replicate). All gilts were initially subjected to a standard estrus synchronization regimen, which included oral administration of altrenogest (20 mg per day for 18 days) and a single intramuscular injection of 400 IU of equine chorionic gonadotropin and 200 IU of human chorionic gonadotropin (PG600) on the last day of altrenogest administration. The gilts were then randomly allocated to either the control group (CTR; boar contact) or the experimental group (TRT), which received a nasal spray treatment of Boarbetter® (4 mL/gilt).

A total of 629 gilts (97.1%) [312 TRT (98.1%) and 317 CTR (96.1%); P>0.05] showed signs of estrus (backpressure test) and were artificially inseminated with Danish Duroc semen (2´$10^9$ spermatozoa/80 mL of inseminate dose). The estrus synchronization rate (97.1±1.8%; mean±standard deviation) did not vary (P>0.05) between TRT and CTR groups or among the four study replicates. Pregnancy (93.7±3.8%) and farrowing (89.5±1.7%) rates, as well as litter size (17.7±4.4) and mean number of liveborn piglets per gilt (15.9±3.7), did not differ (P>0.05) between the two groups of gilts or over time.

Our results indicate that Boarbetter® effectively replaced boar contact as a method for estrus synchronization in replacement gilts.

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# Ultrasonographic Estimation of Loin Physicochemical Characteristics in Live Pigs

Abstract 2025-022

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At present, a non-invasive method for accurately predicting the physicochemical and sensory characteristics of pork from the examination of skeletal muscles in live animals is not available. Such a method would significantly aid livestock genetic selection and improvement programs, as well as enhance the pork quality and consumer satisfaction. We have developed a computer algorithm called r-Algo, which analyzes ultrasound images of muscles and identifies the specific ranges of image pixel intensity values with the strongest correlations to quantitative muscle characteristics. The main objective of this study was to validate r-Algo for estimating proximate chemical composition, fatty acid content, and select physical/sensory attributes of the longissimus dorsi (LD) muscle in fatteners.

The present experiment utilized 44 Polish Landrace fatteners fed in a two-phase cycle (grower and finisher, a total duration of approximately 100 days). All animals were kept in individual pens and fed *ad libitum* with commercial dry mixes containing wheat and barley middlings, and 20-60% corn. Just prior to slaughter, the left LD was scanned with a 7.5-MHz linear probe in the longitudinal (LONG) and transverse (TRSV) planes. Meat samples were collected immediately after slaughter and assessed with standardized laboratory tests or by trained expert panels (sensory characteristics) to provide benchmark values for the validation of the r-Algo software.

A total of 22 different characteristics were determined in LD muscle samples. Significant correlations among echotextural characteristics of r-Algo-identified pixel intensity ranges were recorded for all meat characteristics studied. Mean estimated values did not differ statistically from the reference (accepted) values for all parameters except for cholesterol and protein content, thermal loss, color lightness (L*), and aroma (indicative of inadequate precision). The accuracies of estimates were consistently satisfactory (>65%), except for the estimates of yellowness (b*). For the remaining variables in the three different categories, the highest predictive accuracies were recorded for MUFA content (97.34% - chemical), springiness (92.47% - physical), and taste (95.56% - sensory).

Algorithm-assisted analyses of LD ultrasonograms in live fatteners provide accurate estimates of an array of physicochemical and sensory characteristics of pork samples.

# Meta-Analysis of Copper Digestive Utilization with Phytase in Weanling Pigs

Abstract 2025-023

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Exogenous phytases have been widely used as feed enzyme supplements in the global swine industry for more than 4 decades. However, there are inconsistent literature reports of efficacy of the exogenous phytases in modulating the digestive utilization of dietary copper (Cu) in weanling pigs. A literature reviewing-based meta-analysis was conducted to determine the effect of dietary exogenous phytase supplementation (500–1000 FTU/kg) on the digestive utilization of dietary Cu in weanling pigs. This meta-analysis study included work published between 1992 and 2023 on weanling pigs fed dietary Cu levels within Cu requirements without or including exogenous phytases.

Data normality was checked by the Shapiro-Wilk test. The Kruskal-Wallis non-parametric contrast showed no difference in the apparent fecal Cu digestibility (16.8±5.2 vs. 22.0±6.4%; $P$=0.53; n=23 vs. 10) between the non-phytase and the phytase groups. There was an exponential relationship [Y=exp(0.175±0.059x); $R^2$=0.36; $P$<0.05; n=23] between the contents (mg/kg dry matter diet intake, DMI) of the apparent fecal digestible Cu and the total dietary Cu in the non-phytase group, suggesting that the true fecal Cu digestibility was affected by dietary Cu levels. There were linear relationships (y=0.339±0.119x; $r^2$=0.28, $P$<0.05; n=23 for the non-phytase group vs. y=0.275±0.110x; $r^2$=0.44; $P$ < 0.05; n=10 for the phytase group] between the contents (mg/kg DMI) of the apparent fecal digestible Cu and the total dietary Cu, thus allowing estimation of the true fecal Cu digestibility values between the two groups. The Kruskal-Wallis non-parametric contrast showed differences in the fecal endogenous Cu output (2.331±0.759 vs. 0.656±0.967 mg/kg DMI; n=23 vs. 10; $P$=0.0052) between the non-phytase and the phytase group.

Thus, our meta-analysis results indicate that exogenous phytases did not improve the apparent and true fecal Cu digestibility but significantly reduced fecal endogenous Cu loss in weanling pigs.

**Meta-analysis of Fibre Enzymes in Growth and Nutrient Digestibility in Weanling Pigs**
Abstract 2025-024

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Dietary fiber has long been recognized as an anti-nutritive factor. It limits dietary nutrient digestibility and profit margins and contributes to the biogenesis and emission of the major greenhouse gases in intensive swine production. Exogenous fibre enzymes have been used as feed enzyme supplements in the global swine industry for more than two decades. However, there are inconsistent literature reports of efficacy of exogenous fibre enzymes in modulating growth performances and nutrient digestibility in weanling pigs.

We carried out literature reviewing and meta-analyses of a total of 35 studies published between 2003 and 2024 that examined the impact of exogenous fiber enzyme supplementation on growth performances and nutrient digestibility in weanling pigs fed typical commercial diets formulated with oil meal, cereal grain, by-product, and co-product.

There were no differences ($P > 0.05$) between the non-enzyme and the fibre enzyme-supplemented groups in the initial body weight (7.91±0.35 vs. 7.68±0.28 kg) and the major dietary contents (as-fed basis) of net energy (2463±63 vs. 2462±63 kcal/kg), crude fat (7.98±2.72 vs. 8.12±2.73 %), neutral-detergent fibre (NDF) (12.16±0.77 vs. 13.14±0.85 %) and lignin (0.82±0.23 vs. 0.84±0.28 %), respectively. Furthermore, dietary supplementation of various exogenous fiber enzymes of cellulases and hemi-cellulases in single and/or in combination had no effects ($P > 0.05$) on growth performances of average daily gain, average daily feed intake and gain to feed ratio as well as the apparent total tract digestibility (%) of dry matter (82.8±0.8 vs. 83.3±0.9), NDF (53.5±2.3 vs. 55.6±2.5) and crude fat (69.2±8.8 vs. 70.3±9.3) in weanling pigs fed typical commercial diets.

Therefore, our meta-analysis results suggest the notion that currently available commercial exogenous fiber enzymes have limited efficacy for improving growth performances and dietary nutrient digestibility in weanling pigs. More efficacious exogenous fiber enzymes need to be further developed for swine feed industry applications.