Economic losses associated with ileitis

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HIGHLIGHTS

- Based on a survey of swine veterinarians, the value of productivity losses and increased animal health costs in pigs affected by ileitis in the finishing phase was estimated to be **USD4.65 per marketed pig.**
- Based on results from case-control and experimental challenge studies, the value of productivity losses caused by ileitis in the finishing phase ranged from **USD5.98 to USD17.34 per marketed pig.**
- The cost of the variation in growth caused by ileitis makes it more difficult to feed and market pigs, this adding to the cost of the disease.
- The money spent on animal health interventions, such as vaccines, antimicrobials, veterinary services and diagnostics must be weighed against the benefit of reducing the productivity losses caused by ileitis.

INTRODUCTION

Lawsonia intracellularis (L. intracellularis) is the causative agent of porcine proliferative enteropathy, or ileitis, a disease that affects pigs worldwide *(Lawson et al., 2000)*. In growing pigs, lesions, clinical signs and productivity losses can range from mild to severe. Clinical signs may include diarrhoea, and lesions may range from a thickening of the mucosa in the small intestine and colon to a necrotizing enteritis or a proliferative haemorrhagic enteropathy in more severely affected pigs *(Rowland et al., 1975)*. Pigs may be affected any time during the growing phase, but productivity losses related to ileitis are most significant in the finishing stage of production, from approximately 20 kg to market weight *(Bane et al., 2001).*

Clinical signs of pigs affected by ileitis include diarrhoea and emaciation. However, affected pigs will frequently grow more slowly and require more feed per unit of weight gain even without diarrhoea or emaciation. This is sometimes referred to as subclinical disease, implying that productivity losses are not characterized by overt clinical signs.

Ileitis is a prevalent problem worldwide. Based on a 2012 survey of producers in the United States conducted by the National Animal Health Monitoring System *(USDA, APHIS, NAHMS, 2016)*, ileitis was reported as a disease problem on 28.7% of growing/finishing sites.

ESTIMATES OF ECONOMIC LOSSES

In a 2006 study where veterinarians were surveyed to rank and quantify productivity and economic losses due to the major health challenges in 19 large swine production companies in the US, ileitis was ranked as a health challenge in 14 of the companies *(Holtkamp et al., 2007)*. In the same study, the value of productivity losses and increased animal health costs in pigs affected by ileitis in the finishers were estimated to be USD4.65/pig marketed with total losses in the US estimated to be USD56.1 million annually (unpublished data).

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SOURCES OF ECONOMIC LOSSES

PRODUCTION LOSSES

The major source of economic losses associated with ileitis arises from productivity losses caused by the disease. Pigs affected by ileitis grow more slowly and have a worse feed conversion ratio. Slower growth is measured by a reduction in the average daily gain (ADG) and a less efficient conversion of feed into weight gain is measured by an increase in the feed conversion ratio (FCR). The disease may also result in an increase in the percentage of culled pigs, and in some cases it may cause mortality, resulting in an increase in the culling and mortality rates.

Good estimates of productivity losses caused by ileitis are difficult to make due to the lack of sufficient data collected by producers.

The most significant data gap arises from the difficulty in classifying groups of growing pigs as affected or unaffected by ileitis.

Diagnostic tools are available to determine if pigs are shedding *L. intracellularis*, have antibodies against *L. intracellularis* (this indicating a previous infection) and whether the bacterium is associated with lesions. However, the diagnoses add to the production costs and are carried out infrequently and rarely, routinely. When diagnoses are carried out, the industry lacks a widely accepted definition for classifying groups of pigs as affected or unaffected based on the diagnostic results.

In practice, observing clinical signs is less expensive than performing diagnoses, but it is something subjective, and the lack of overt clinical signs in subclinical cases makes it impossible to rely on clinical signs to classify groups as affected. However, lacking good data from producers, published observational studies and controlled experimental challenge studies can provide a basis for making reasonable rough estimates.

REDUCED ADG AND POORER FCR

Published studies provide a basis for estimating the extent to which ileitis impacts on ADG and FCR (Table 1). A case-control study comparing herds affected by ileitis with those not affected by the disease reported that ADG from wean-to-finish was reduced by 9% and that FCR increased by 7% *(Fourchon et al., 2000).* Herds were classified as positive or negative based on their serological status.

Several experimental challenge studies, comparing non-challenged (negative control) pigs to challenged (positive control) pigs have also been published. All the studies summarized in Table 1 included a negative control and at least one group of challenged pigs and none of the studies included any groups of pigs that were treated with a vaccine or antimicrobials. The age of the pigs when challenged and the challenge dose varied in each study. In general, the impact on ADG and FCR is greater in younger pigs and increases as the challenge dose increases. In the case of the experimental challenge studies in which the pigs were younger than 42 days at the time of the challenge (Guedes et al., 2003; Paradis et al., 2012; Shurson, 2002a), the reduction in ADG ranged from 37% to 79%, and FCR increased from 37% to 194%. However, experimental challenge studies in which pigs were 42 days (6 weeks) and older represent more closely the timing of the infections in the field. In studies where the pigs were 42 days or older at the time of challenge (Shurson et al., 2002b; Beckler et al., 2012; Collins et al., 2014a,b), the reduction in ADG ranged from 3% to 19%. The impact on FCR was only reported in one of the studies on older pigs (Collins et al., 2014a) in which it was reported to increase by 7%.

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The range of the impact on affected pigs in the finishing stage of production in the studies in which the pigs were 42 days or older at the time of challenge were:

- Reduction in ADG: 3% to 19%
- Increase in FCR: 7%

MORTALITY AND CULLS

In more severe forms of the disease, mortality may also occur, especially later in the growing phase. In the case-control study conducted by Fourchon *(Fourchon et al., 2000)*, the wean-to-finish mortality rate was 5.4% in negative farms and increased by 1.3% to 6.7% in positive herds (an increase by 24%). The culling rate may also increase as more severely affected pigs may fail to grow fast enough to reach weights that are accepted by primary markets.

Table 1. Summary of production losses from case-control and experimental challenge studies.

Study name	Age of pigs / length of the study (days)[1]	Challenge dose[2]	ADG NegCont (g/day)	ADG Challenged (g/day)	% Change vs NegCont	FCR NegCont	FCR Challenged	% Change vs NegCont
Case Control Studies								
Fourchon et al., 2000	Wean-to-finish	NA (Natural Challenge)	605[3]	550[4]	-9%	2.56[3]	2.75[4]	7%
Experimental Challenge Studies								
Guedes et al., 2003	35 / 20	H: 5.4 x 1010 M: 5.4 x 109 L: 5.4 x 108	440	H: 91 M: 186 L: 259	H: -79% M: -58% L: -41%	1.7	H: 5.0 M: 2.9 L: 2.4	H: 194% M: 71% L: 41%
Paradis et al., 2012	14 / 21	B: 2.4 x 108 C: 7.2 x 107 D: 2.2 x 106 E: 3.8 x 105 F: 3.2 x 104	A: 396	B: 155 C: 190 D: 237 E: 234 F: 249	B: -69% C: -52% D: -40% E: -41% F: -37%	A: 1.63	B: 2.92 C: 2.51 D: 2.24 E: 2.1 F: 2.01	B: 79% C: 54% D: 37% E: 29% F: 27%
Shurson, 2002a	40 / 21	1.56 x 10^9	600	311	-48%	2.27	3.22	42%
Shurson, 2002b	45 / 21	Not reported	799	672	-16%	1.6	1.7	7%
Beckler et al., 2012	66 / 24	H: 1.08 x 107 M: 1.83 x 105 L: 3.45 x 104	838	High: 700 Med: 762 Low: 809	H: -17% M: -9% L: -3%	Not Reported	Not Reported	Not Reported
Collins et al., 2014a	63 / 21	5.9 x 10^9	793	664	-16%	Not Reported	Not Reported	Not Reported
Collins et al., 2014b	42 / 21	5.9 x 10^9	688	558	-19%	Not Reported	Not Reported	Not Reported

1. The age of the pigs was the age when challenged. The length of the study is the time over which ADG and FCR were measured following the challenge.
2. L = Low, M = Medium, H = High.
3. Classified as Negative (Control) herds by serology.
4. Classified as Positive herds (Cases) by serology.

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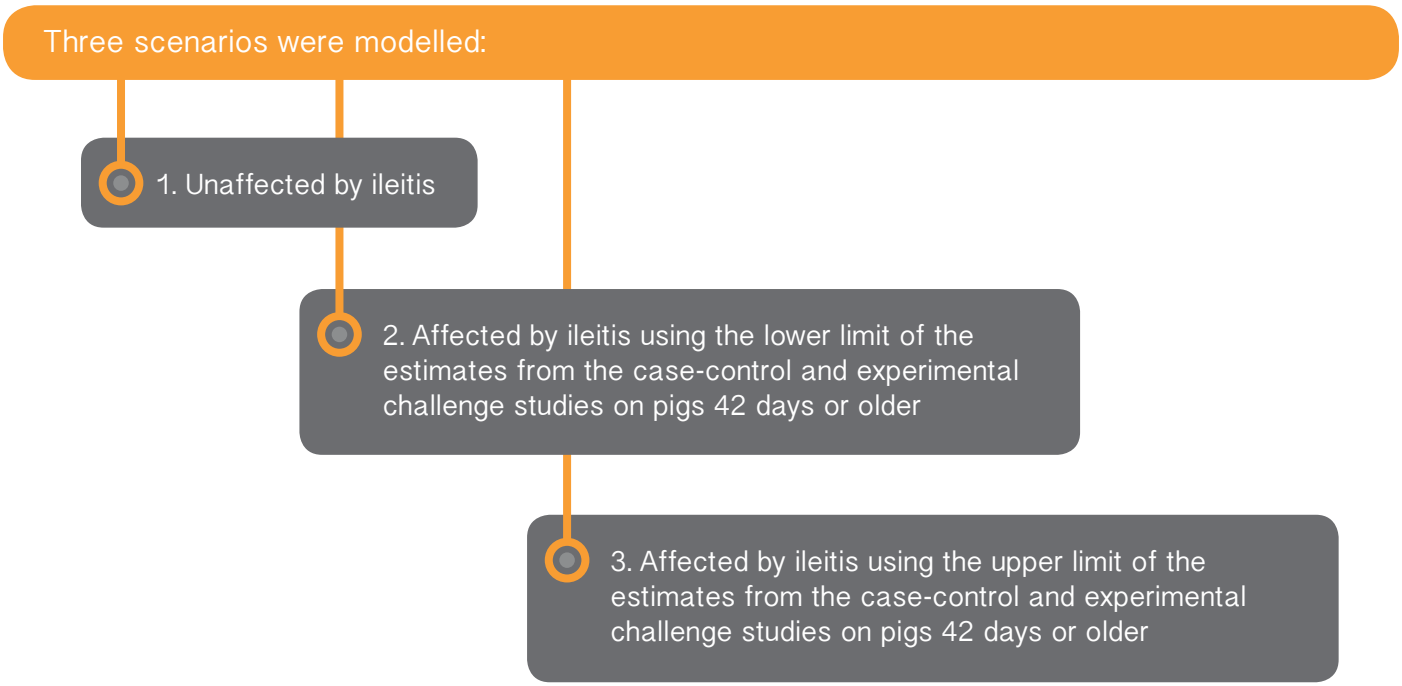
Economic value of the estimated productivity losses.
To estimate the value of changes in productivity caused by ileitis, an economic analysis was carried out using a production and economic model.



For the Unaffected by ileitis scenario, the baseline value for ADG was 0.90 kg/day, 2.950 for FCR and 4.0% for mortality. The lower and upper limits regarding the reduction in ADG were 3% and 19%. Due to the limited number of studies reporting FCR, a 7% increase was used for both the lower and upper limit scenarios.

The mortality rate for the lower limit was unchanged from the Unaffected rate of 4.0% and increased to 5.0% for the upper limit, an increase by 24.0%, based on the results from the Fourchon study *(Fourchon et al., 2000).*

An average start weight of 22 kg and 115 days on feed was used in each scenario. Therefore, as ADG decreased, the average market weight also declined. A market pig price of USD1.76/kg and a feed price of USD190/tonne were used in the model.

The feed price was an average price for all finishing diet phases. Only the ADG, FCR and mortality rate changed between each of the scenarios. The values of the rest of parameters were held constant for all three scenarios. The results of the economic analysis are presented in Table 2.

The value of the poorer ADGs, FCRs and mortality rates were calculated as the change in profit from the Unaffected by Ileitis scenario. The value of the lost productivity caused by ileitis ranged from USD5.98 for the lower limit to USD16.94 for the upper limit.

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Table 2. Estimated value of the poorer ADGs, FCRs and mortality rates caused by ileitis.

	Unaffected by ileitis	Affected, Lower limit[1]	Change vs Unaffected	Affected, Upper limit[2]	Change vs Unaffected
Average live weight at market (kg/pig)	126.2	123.1	-3.1	106.5	-19.7
Revenue (USD/pig marketed)	USD165.38	USD161.33	-USD4.06	USD139.69	-USD25.70
Production cost (USD/ marketed pig)	USD146.54	USD148.46	USD1.92	USD137.79	-USD8.75
Net profit (USD/ marketed pig)	USD18.84	USD12.86	-USD5.98	USD1.90	-USD16.94

1. Lower limit:
   - ADG decreased from 0.90 to 0.87 kg/day (-3.0%)
   - FCR increased from 2.950 to 3.157 kg feed/kg gain (+7.0%)
   - Mortality rate did nor change

2. Upper limit:
   - ADG decreased from 0.90 to 0.73 kg/day (-19.0%)
   - FCR increased from 2.950 to 3.157 kg feed/kg gain (+7.0%)

VARIATION

The major source of economic losses associated with ileitis arises from productivity losses caused by tIn groups of pigs affected by ileitis, pig-to-pig variation in average daily gain is seen, as some pigs may be affected more than others. System constraints contribute to the economic consequences associated with variation. Constraints common to most producers arise from limited fixed resources, such as building space, and management-imposed constraints on such things as the flow of pigs in the system. The number and size of the facilities places a limit on the number of animals and on the time that the animals can stay in each facility.

When the variation in the weight of the pigs increases due to the disease during the growing period it becomes more difficult to feed and market the pigs. Diets will be over-fortified for heavier pigs and under-fortified for lighter pigs.

Depending on where the producers target the diet in each growth stage, the cost of feed will rise if diets are over-fortified, and growth and feed conversion will suffer if diets are under-fortified. At marketing, the increased variation in pig weights makes it more difficult to market pigs in the group at optimal weights. Heavier pigs may be marketed earlier, but pigs at the lighter end of the weight distribution cause the most problems.

If space is available in the facilities, the lighter pigs may be kept on feed for a longer period. However, when space is limited, as is usually the case, the lighter pigs are marketed at less-than-optimal weights, this resulting in a loss of revenue and profit.

Depending on if the space in the facilities is owned or contracted, tying up the space for a longer time may also increase costs.

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INCREASED ANIMAL HEALTH COSTS

The cost of animal health interventions, such as vaccines, antimicrobials, veterinary services and diagnoses, are not directly caused by ileitis but rather occur in response to the disease. Money spent on these interventions must be weighed against the benefit of reducing the impacts of the disease described above. A cost-benefit analysis can provide valuable information to help producers and veterinarians decide which interventions to use.

CONCLUSIONS

The major source of economic losses associated with ileitis arise from productivity losses caused by the disease. In the finishing phase, where the losses due to ileitis are most significant, pigs affected by ileitis will have a lower ADG and an increase in the FCR, and occasionally an increase in mortality and culling rates. Other economic losses arise from increased pig-to-pig variation in average daily gain, as some pigs may be affected more than others. Variation in growth caused by ileitis makes it more difficult to feed and market pigs, this adding to the cost of the disease.

Few estimates of the cost of ileitis have been published. In one study, based on a survey of swine veterinarians, the value of productivity losses and increased animal health costs in pigs affected by ileitis in the finishing phase was estimated to be USD4.65 per marketed pig.

It is difficult to make good estimates of productivity losses due to ileitis because of the lack of sufficient data collected by producers.

Lacking good data from producers, published observational studies and controlled experimental challenge studies can provide a basis for making reasonable estimates. Based on results from a single case-control and several experimental challenge studies, the estimated value of productivity (ADG, FCR and mortality) losses caused by ileitis in the finishing phase ranged from USD5.98 to USD17.34 per marketed pig.

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