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Biosecurity practices on intensive pig production systems in Chile

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Abstract

Chile eradicated classical swine fever (CSF) in April 1998, following a 17-year eradication programme. The authors describe biosecurity levels of pig farms in Chile after the eradication of CSF. A formal survey was administered to 50 large integrated pig farms, which represented almost 60% of the swine population. The main topics on the questionnaire were production, health management, biosecurity, insurance and information about CSF outbreaks in the past.

Biosecurity practices were analysed according to the criteria stated by Barcelo and Marco in 1998. A scoring system to measure biosecurity was designed and pig farms were classified according to this score. An adjusted specific measure is discussed as a potential indicator of risk for disease infections. The authors explore associations between biosecurity herd size and insurance policy against CSF.

Keywords: Biosecurity; Pig production; Swine health; Risk; Pig diseases

1. Introduction

In swine production, biosecurity is defined as the protection of a swine herd from the introduction and spreading of infectious agents (viral, bacterial, fungal or parasitic) (Armass and Clark, 1999).

Chile is free of the major infectious diseases of swine. High biosecurity in Chilean pig production systems is required to prevent introduction and spread of highly infectious

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diseases such as classical swine fever (CSF), foot-and-mouth disease (FMD) or Aujeszky's disease.

Pig production requires a secure environment and excellent hygienic conditions. Differences in scale of production, standards of biosecurity, production inputs and marketing practices among pig farms can affect the potential risk of disease transmission. These variables can be quantified to provide an indicator of the risk of introducing diseases onto pig farms through such mechanisms as movement of pigs or contaminated feed.

Biosecurity has been defined as "the application of health controls and measures to prevent introduction and spread of new infectious agents into herds" (Barcelo and Marco, 1998). The role of biosecurity is also to prevent the spread of current or existing (and not only new) infectious diseases. Those authors described the lack of information about aspects of biosecurity and their relationship to the risk of diseases. However, the same authors showed that outbreaks of CSF in The Netherlands and Spain were attributed to the lack of biosecurity on pig farms. Quantification of biosecurity at the farm level might be helpful for prevention of exotic diseases such as CSF or FMD or transmission of endemic diseases such as salmonella or porcine respiratory and reproductive syndrome (PRRS). According to Armass and Clark (1999), there is a lack of scientific evidence to support biosecurity measures implemented by the pig industry.

Approximately 150,000 sows are kept in commercial herds in Chile, producing some 3,000,000 slaughter pigs per year. Pig production is highly concentrated on large pig farms that produce almost 90% of the swine population. The rest of the pigs are located on small farms and back-yard systems.

There is much diversity in scale of production, standards of biosecurity, production inputs and marketing practices amongst the integrated pig farms in Chile (farms with >50 breeding sows); however, by standards in North America and Europe, 50, 100, even 500 sows are not considered "large operations". These differences likely affect potential risk of disease introduction and spreading of diseases.

The success of a good swine health-management programme must include the daily monitoring of housing and environment to ensure adequate levels of hygiene and ventilation. Practices included in a biosecurity programme such as down time (depopulated) period, cleaning and disinfecting are common in pig production.

In this paper, the authors describe the use of a biosecurity score and index as indicators of susceptibility of pig farms to the introduction and transmission of infections, taking into account the nature of each pig farm. Also, the score and index could provide a baseline of quantitative information to enable quantification of premiums for insurance policies or public compensation in case of outbreaks.

The objectives of this study were to:

- Measure (by means of a questionnaire) biosecurity and production levels of a large segment of the pig industry in Chile.
- Establish a biosecurity score as a measure of the degree of biosecurity as a potential risk for the introduction and spreading of infections between farms.
- Analyse the relationship between biosecurity levels, herd size and use of insurance against CSF.

2. Materials and methods

We designed a cross-sectional study in which a formal questionnaire was administered to the managers of 50 large pig farms in the central region of Chile in 1998. Farms were sampled by convenience within a group of 300 intensive pig farms covering almost 80% of the pig population in the country.

The farms included in this study covered almost 60% of the Chilean pig inventory. Some of these large pig farms were described as having good management practices and production parameters such as high number of piglets per litter and parturitions per sow per year (Table 2). Some of them were implementing well-developed marketing and pork export strategies.

Before the questionnaire was applied, a testing of the questions included in the questionnaire was carried out in five pig farms in order to pre-test the questionnaire. The structure of the questionnaire included closed and semi-closed questions for each component of biosecurity reviewed.

Veterinarians of the National Veterinary Services administered the survey on each farm and Veterinarians were trained to provide uniformity in the administration of the survey. The survey was entirely voluntary, and the number of respondents varied for each component of the questionnaire. The questionnaire sections were hygiene, cleaning, and general management on each farm. The authors speculate that these components were related directly or indirectly to the spread of infectious diseases.

A biosecurity scoring system was developed for pig production using as its basis the principles described in poultry production (Leslie, 1996) and selecting categories according to Barcelo and Marco (1998). The variables or factors included in the biosecurity score are quarantine, sanitation, hygiene, replacement of breeding sows, etc. The presence or absence of specific components of biosecurity is identified in Table 1.[1]

Each component for the biosecurity score was considered in one of the following categories suggested by Barcelo and Marco (1998):

(1) *Location and isolation*. This is the most important factor to prevent the entry of infectious agents in a pig farm. Only an isolated farm will have a good prevention, especially of airborne diseases. Components considered in this category could receive 0 or 2 points each for the biosecurity score.
(2) *Internal risks*. This includes all the hazards within the farm such as pest control, presence of domestic animals, pig disposal of sick and dead animals. Components considered in this category could receive 0 or 2 each for the biosecurity score.
(3) *Moveable risks*. This component includes things or elements such as feed, waste management, use of water and people which are being moved within on from outside of the farm. Components considered in this category could receive 0 or 1 point each for the biosecurity score.
(4) *Non-moveable risks*. This implies elements that are fixed within the farm (use of a fence, main entrance, changing facilities, etc.). Components grouped in this category could receive 0 or 1 point each for the biosecurity score.

[1] The survey instrument is available upon request.

Table 1
Biosecurity practices in Chilean swine farms, 1998 ($n = 50$ pig farms)

Category	Components of biosecurity	Yes (%)	No (%)	No answer (%)
1	Replacement breeders	16	72	12
1	Separated units	84	8	8
1	Replacement come from within the farm “own replacement”	36	52	12
1	Separate entrance for each maternity facility	58	28	14
1	Quarantine new pigs on arrival	56	36	8
1	Close to smallholders/less than 2 km	20	68	12
1	Personal keep pigs at home	6	86	8
2	Period without production between batches of pigs	84	6	10
2	Disease records	72	20	8
2	Slaughtering within the farm	36	56	8
2	Disposal of pigs in an incinerator	46	46	8
2	Disposal of pigs in the garbage	6	86	8
2	Slurry disposal as manure	30	48	22
2	Slurry disposal in a septic tank	50	42	8
3	Feed movement (exclusive by section)	64	22	14
3	Labour exclusively in maternity	44	42	14
3	Water is a from safety source	8	84	8
3	Personnel not move between sections; fixed labour for each section	80	12	8
4	Equipment is not shared by different sections	82	6	12
4	Equipment is used exclusively by maternity section	6	82	12
4	Use of fenceline	78	14	8
4	Control of visitors	86	6	8
4	Shower before entering facilities and changing (clothes)	68	24	8
4	Clean and disinfect trucks	56	36	8
4	Use of wheel bath for trucks at the entrance of the farm	40	52	8
4	Use of feet bath	66	26	8

Higher scores always implied “better” biosecurity. The maximum possible score is 40 points. The final sum for each biosecurity score was tallied using a simple spreadsheet in EXCEL (Microsoft Corporation).

The scores for biosecurity were analysed with non-parametric techniques (Mann–Whitney test; two-sample rank test of the equality of two population medians) to compare biosecurity of pig farms with use of insurance and also to compare the herd size with insurance (Minitab, 2000).

Another non-parametric technique, the Kruskal–Wallis test of the equality of medians for multiple groups, was used to compare biosecurity by herd size (three categories). The herd categories were: <100 breeding sows (small size), between 101 and 1000 breeding sows (medium size) and finally >1000 breeding sows (large).

2.1. Results

The percentage of farms using each of the positive or negative biosecurity components is presented in Table 1.

In this survey, a high proportion of farms had perimeter fences (78%) and used a protocol of quarantine procedures. A fenceline around a farm is important because many large farms were surrounded by small pig producers which could be a source of hazards.

The use of quarantine of new pigs on arrival (56%) identified in this survey is similar to results obtained in the National Animal Health Monitoring Systems (USA) which described that between 33.6 and 60.9% of the producers separate or quarantine new breeding animals on arrival.

The use of disease records is a critical point in animal farms, but in Chile, only 72% of the farms reported having a disease records system (Table 1). About 86% restricted entry to visitors and 68% of the farms required showers prior to entry.

For pig farms that allowed trucks transporting pigs onto their farms, only 56% required cleaning and disinfecting for trucks before entry to the pig farm and 40% required use of a wheel bath.

Biosecurity scores ranged from 9 to 28 points and were not normally distributed. The score median was 20. Using the Kruskal–Wallis test, there was no difference between herd size groups (small herds, biosecurity median = 19, medium herd size = 21 and large herd size = 22) ($P = 0.17$).

The Mann–Whitney indicated that farms with insurance were associated with large herd size (median = 487 breeding sows in insured farms vs. median = 298 in non-insured farms) compared with the group without insurance ($^*P = 0.015$). Biosecurity score was not size different for insured farms (median biosecurity in insured = 21 and median biosecurity in non-insured = 20) ($P = 0.50$).

In this study, most production parameters in pig farms were not related to biosecurity scores in pig farms (Table 2). Two categories of farms (farms with biosecurity below 20 points and farms with scores higher than 20 points) were analysed. However, differences were demonstrated in the replacement risks (rr) observed in farms with good biosecurity

Table 2
Production parameters in 50 Chilean pig farms

Parameter	Minimum	Q1	Q2	Q3	Maximum
Herd size (sows)	50	193	420	825	3000
Farrowing %	66.4	85.7	89.0	90.2	95.0
Pigs born alive (no per litter)	8.6	9.8	10.5	11.0	12.1
Weaned pigs (no per litter)	7.3	9.3	9.9	10.2	11.1
Pre-weaning death %	2.0	4.7	6.0	7.9	21.0
Age of pigs at sale (months)	4.0	5.0	5.1	5.5	6.0
Live weight at sale (kg)	81	92	95	100	112
Litters per sow per year	1.7	2.2	2.4	2.4	2.5
% replacement of breeding sows[a]	10	31	40	50	59
Abortion %	0.1	0.3	1.0	1.5	2.5
Floor surface of building per sow (m^2)	0.62	1.31	1.32	1.5	4.0
Downtime (days) in normal production time; fattening	1	2	4	5	15
Downtime in intensive production time; fattening	1	1	2	3	15
Downtime (days) in normal production time; maternity[a]	1	2	4	5	10
Downtime (days) in intensive production time; maternity	1	1	2	3	7

[a] $P \leq 0.05$ between farms with biosecurity scores >20 vs. those with scores <20.

levels (score > 20, rr $= 44\%$) compared with the replacement of pig farms with low biosecurity score (score < 20, rr $= 34\%$) ($^{*}P = 0.05$). Also, downtimes (the days that facilities are empty between batches of pigs) in maternity in farms with high (~3 days) vs. low (~5 days) biosecurity scores ($^{*}P = 0.04$).

3. Discussion

In this study, we used 26 factors to evaluate biosecurity. These factors were classified according to Barcelo and Marco (1998) in categories related with isolation, internal risks, moveable and non-moveable risks. The weight of each factor could be argued, but in this case all the factors related with isolation and internal risks received higher weight in the final score.

One of the weaknesses of this cross-sectional study was that it was not possible to follow biosecurity across time and therefore to validate it by monitoring biosecurity and disease occurrences over time. Only single point estimation was used to evaluate biosecurity in pig farms as an indicator of preparedness against introduction and transmission of pig diseases at farm level. The monitoring of these characteristics across time might provide knowledge about the behaviour of pig farmers regarding preventive measures.

Pig farms with low biosecurity scores theoretically have higher potential for introduction and spread of diseases, while farms with higher values would present a lower potential risk of infection. A high proportion of pig farms in this survey had poor preventive measures therefore a low biosecurity score.

These variations of biosecurity suggested that measures must be improved in farms with low scores in order to minimise chances of infection by diseases (Dijkhuizen, 1999).

Variability of the biosecurity score used to evaluate prevention measures was not related with use of insurance policy against CSF, but herd size was related to the decision to purchase an insurance policy. This may be explained by the lack of government indemnity funds, and the large money investments in larger farms. The original insurance contract was drafted in a very straightforward manner. It provided for compensation of up to a total of US$ 8.82 millions in the event of pigs belonging to participating members of ASPROCER (pig producers association) being slaughtered as a result of CSF during the period of cover. Compensation would be paid according to a schedule of standard values for sows, boars and followers. The first 15% of any claim (subject to a minimum of US$ 10,000) would be borne by the livestock owner. The premium payable covered sows and their followers (US$ 2.95 per sow).

Other possible factors include risk perception by farmers and knowledge of their own preventive measures (biosecurity). Monitoring of biosecurity is recommended to evaluate effects of insurance policy and improvements in biosecurity, especially in large pig farms. Herd size has been demonstrated as one of the main risk factors for animal diseases. Farms with many animals tend to have an increased amount of animal movement, an important risk factor for diseases such as CSF, especially in areas of high animal density (Horst et al., 1997; Stark, 1998). Perhaps this and the ban of vaccination in 1998 are the main reasons why producers perceived themselves at higher risk, and purchased insurance.

On the other hand, in this study biosecurity was not related with the main production parameters in pig production systems. However, a high replacement rates and a small downtime period in maternity are related with high biosecurity scores This could present implications in order to evaluate the risks of diseases in farms with this kind of management practices.

For instance, the risk of CSF outbreaks in Chile now derives from virus being introduced from outside Chile, or from possible infection in wild-boar populations.

In Chile an insurance policy must be based on the individual risks faced for each farm. A. James (2002, personal communication) concluded that the insurance arrangement has served its purpose very well, but that, in the present situation, an alternative system of compensating producers is needed.

Consideration could be given to setting the levy at a higher rate than that required to fund the compensation scheme. The additional revenue could be used to finance a fund for the further development of biosecurity in the pig industry. This fund could be managed jointly by ASPROCER and SAG to develop systems and controls that would limit the spread of any infectious disease in the pig population, and help to meet the ever-increasing requirements of disease status, food safety assurance and traceability demanded by international markets for livestock products.

4. Conclusions

There is a wide variation of preventive measures adopted on Chilean intensive pig farms to control the introduction and spread of diseases. These practices are related to cleaning procedures, management practices and trade of pig products. Only 25% of the farms surveyed for biosecurity were over the third quartile for this parameter.

Biosecurity score was not related with herd size and insurance against CSF purchased by pig farms.

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