Analysis of Findings and Recommendations to Minimize Risks of Contamination in Canadian Buildings with Air Filtration Systems

Introduction

The present fact sheet lists the main findings and recommendations to avoid the re-occurrence of problems encountered in the past in Canadian swine buildings with air filtration systems. Cases of contamination were reported in these buildings and causes were documented to target the parameters to be corrected to reduce the risks of subsequent cases. The equivalent was performed for American buildings with air filtration systems based on information provided in the literature and by the American experts in order to achieve comparisons between Canadian and American farms to explain the differences in performance on the contamination rate.

A PADRAP (Production Animal Disease Risk Assessment Program) analysis enabled the identification of the main risks of introduction and spread of the PRRSV and, consequently, opportunities for improving the biosecurity protocols of herds in Canadian buildings with air filtration systems.

Probable Causes of Contamination from Investigation Reports

- Manure spreading was identified on one occasion as the source of the PRRS. The introduction of the strain must, however, have been related to a biosecurity breach on the site;
- Entry of contaminated gilts during a restocking;
- Problems related to the building envelope and/or the air filtration system tightness;
- Absence of sufficiently airtight backdraft dampers on fans;
- Failure to observe the biosecurity code in force in the herd:
  - Maintenance staff having entered contaminated products or equipment into the farm;
  - Poor reaction time from the staff in repairing an airtightness break;
- Presence of a chronic PRRSV field strain in the herd and genetic evolution (mutation) of the strain up to a new clinical outbreak;
- Failure of producers to comply with the recommendations with regard to buildings upon installation of the filtration system;
- Aerosols.

Main Recommendations to Avoid Reproducing Errors Mentioned in Investigation Reports and to Reduce Cases of Contamination

- Budget, from the beginning, all adaptations required to the building based on air filtration specialist recommendations prior to starting a new filtration project. Ensure that the specialists (ventilation engineer, veterinarian, filtration system supplier, etc.) have properly evaluated your needs in the field;
- Reduce the risk upon gilts introduction:
  - Option 1: Filter the gilt facility and use a trailer equipped with an air filtration system to carry the gilts to the farrowing barn;
  - Option 2: Define a "quarantine" section in the farrowing barn with the air filtration system:
    - This section must have a ventilation system and a manure evacuation system (e.g. Pull plug) independent of the rest of the building;
    - The air coming out of this section (through the fans) must pass through the filtered air inlets before partially returning to another section of the building, which should be sufficient;
      - Filtering the air coming out of this quarantine section would be an added value (increased security);

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  - An airlock or independent exterior entrance is necessary for the passage of the staff to this internal quarantine section. However, once all serum assays are performed on a group of gilts, an airtight door can be opened to allow free circulation between this section and the rest of the farrowing barn;
- Perform an eradication procedure (including mainly, but not exclusively, an interruption in the introduction of breeding animals) in order to eliminate field strains present in the herd. Do the minimum monitoring necessary to confirm the success of the procedure;
- Increase the building's airtightness (e.g., doors, windows, ramps, cracks, etc.);
- Increase the enforcement of minimum biosecurity standards;
  - Strongly consider appointing a person (among the permanent staff of the farm) responsible for biosecurity and the maintenance of airtightness;
- Improve the control of pressure differentials between the building and the outside in order not to induce too high a differential that would increase the risk of unwanted entry of unfiltered air;
- Increase the airtightness of filter supports upon their installation;
- Use filters with an appropriate level of air filtration based on the risk observed in the given area;
- Change filters at the end of their active lives (see manufacturer's instructions);
- Installation of an efficient air backdraft system on all fans ideally (since minimum ventilation fans may have a problem and stop running) or at least on the fans running on-off;

It is important to note that the aforementioned recommendations were raised during investigations and do not apply to all of the investigated farms. They are listed in this document for information purposes and must be applied solely after consulting professionals (engineers and veterinarians).

Analysis of Findings and Recommendations

In Canada, to date, no case of contamination has been reported on farms with positive-pressure air filtration systems with HEPA filters

This data seems to corroborate the efficiency reported in other countries using positive-pressure air filtration with HEPA filters for swine buildings:

- Artificial insemination centres
  - Canada
  - United States (Reicks, 2013, personal communication)
  - France
- Farrowing and farrow-to-finish sites
  - Canada (1)
  - France

In Canada, no case of contamination has been reported in artificial insemination centres with negative-pressure air filtration systems

- This result is slightly better than that reported for artificial insemination centres in the U.S.:
  - Annual contamination rate in Canada = 0%
  - Annual contamination rate in the U.S. = 3.5% (Reicks, 2013, personal communication)

The annual contamination rate on commercial farms (farrowing sites essentially, gilt facilities and farrow-to-finish sites in rare cases) with air filtration systems is higher in Canada than in the United States in high-risk areas

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Comparative rates

Table of suspected causes for the 12 cases of contaminations of farms with air filtration systems

Case of contamination	First suspected cause of contamination	Second risk factor identified in importance
1	AEROSOL: Improper installation of filters (non-airtight)	AEROSOL: Deterioration of outdoor filters (UV radiation)
2	BIOSECURITY: Biosecurity break during the manure spreading period	INTRODUCTION OF BREEDING ANIMALS: Contamination of gilts on the road and absence of an isolation section
3	AEROSOL: Improper installation of filters (non-airtight)	AEROSOL: Deterioration of outdoor filters (UV radiation)
4	AEROSOL: Local breakdown of fans allowing the return of unfiltered air	AEROSOL: Improper installation of filters (non-airtight)
5	AEROSOL: Absence of air backdraft dampers	BIOSECURITY: Absence of an airlock (shipping)
6	AEROSOL: Deterioration of outdoor filters (UV radiation)	BIOSECURITY: Absence of an airlock (shipping)
7	INTRODUCTION OF BREEDING ANIMALS: Contamination of gilts on the road and absence of an isolation section	BIOSECURITY: Absence of an airlock (material entry, shipping, etc.)
8	BIOSECURITY: Improper control of maintenance material	AEROSOL: Deterioration of outdoor filters (UV radiation)
9	AEROSOL: The shipping door remained opened for several hours, providing access to the main corridor while viremic pigs were 100 m distant.	
10	INTRODUCTION OF BREEDERS: Contamination of gilts on the road from the restocking	
11	AEROSOL: Several leaks identified (cracks in the building's structure)	BIOSECURITY: Absence of an airlock (shipping)
12	AEROSOL: Risk associated with the access door for the manure pit under the building	INTRODUCTION OF BREEDING ANIMALS: Absence of an isolation section

- Annual contamination rate in Canada = 37% for 14 investigated farms with air filtration systems for the past 5 to 50 months;
  - Data as of end February 2013;
  - Excluding the contaminations from sources known to be other than aerosol, the rate becomes 28%;
  - Excluding the contaminations from sources known to be other than aerosol and avoidable cases of aerosol contamination, the rate becomes 12%;
- Annual contamination rate in the U.S. = 25% for 62 farms;
  - Data as of August 2012 from three animal clinics (Reicks, 2012, personal communication);
- Annualized rate for the last six months in Canada = 29% for 14 farms;
- Annualized rate for the last six months in the U.S. = 21% for 48 farms (Reicks, 2012, personal communication).

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Hypotheses explaining the higher contamination rate in Canada for negative-pressure buildings located in high-risk areas

- Type of filter: antimicrobial filters in Canada vs. mechanical filters in the U.S.:
  - It is clear that the first-generation antimicrobial filter housing were less airtight and less resistant to aging than most common mechanical filter housing;
  - It is also obvious that the first-generation antimicrobial filters showed little resistance to UV radiation for outdoor installations as they were not adequately protected from solar rays.

- Improper installation of filters for lateral air inlets where the air first passes through the eave:
  - No farm in the U.S. is designed with lateral air inlets;
  - Major errors have been observed on all installations equipped with first-generation antimicrobial filters;
    - The design of the building and the air inlets for accommodating the filter housing was not airtight enough;
  - With the new generation of antimicrobial filters, there has been a notable improvement both in the way to fix the filters to the building and in the way to adapt the building and the air inlets in an airtight fashion.

- Proximity of surrounding farms:
  - There have been 12 introductions of new viruses on eight farms in Canada. Seven of these eight farms have at least one neighbour (or even more) between 200 m and 1 km;
  - Unfortunately, data on the distance of the closest farm and the number of surrounding sites in a 3 km radius are not available for American farms. However, the division of agricultural lots in the American Midwest strongly suggests that there are fewer farms in the very close proximity.

- Building envelope tightness:
  - The average age of commercial farms with air filtration systems in Canada is most probably higher than that of American farms;
  - Several of the farms with air filtration systems in Canada are buildings that have evolved (several additions) and changed vocations with years, while the majority of American farrowing barns are original and more airtight structures (built in one stage for the current vocation);
  - The Americans focused earlier on the importance of making buildings airtight;
  - The Americans have installed air backdraft dampers on fans earlier than in Canada.

- Minimum biosecurity standards of Canadian farms with air filtration systems vs. their American counterparts:
  - The proportion of American farms with dedicated rooms for the shipment of animals and the evacuation of carcasses is probably higher than on Canadian farms;
  - The size of American farrowing barns often justifies a person responsible for biosecurity and maintenance (airtightness of the building).

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Opinions in the United States and Canada Concerning the Immunization of Herds with Air Filtration Systems

United States

- Until late 2011, nearly all American farrowing barns with air filtration systems aimed at an eradication upon each contamination event and the introduction of naïve gilts until 100% of the herd became naïve again or until the following contamination occurred.
- Since 2012, according to various personal communications, the majority of farrowing barns with air filtration systems have made sure to maintain the immunity (either using a living commercial vaccine or with serum exposure of the field strain) of the inventory of breeders by exposing the new gilts. Nonetheless, some farrowing barns still advocate the original approach (before 2011) aimed at introducing naïve replacement subjects.
- It should be noted that between the two approaches to maintain minimum immunity, the use of a commercial vaccine seems to be much safer as it is more foreseeable than voluntary exposure to a field strain during an acclimatization period.

Quebec

- In Quebec, the two approaches have been used since the beginning of air filtration for commercial farrowing barns.

Rest of Canada

- All filtered farms have introduced PRRS naïve breeders since the start of air filtration systems;
- It should be specified that these are either artificial insemination centres or nucleus/multiplication units. To our knowledge, there is no commercial farrowing barn with an air filtration system in these regions.

Reasoning

- Considering negative-pressure air filtration has its limitations (it is practically impossible to control all unwanted air infiltrations), the approach aimed at maintaining a PRRS-immune animal population seems to be of interest. Indeed, there is a reason to believe that the risk of outbreak of a contamination associated with a very low aerosol dose of PRRS virus will be reduced if the population at risk was previously exposed to a PRRS strain and is minimally immune as compared with a totally naïve population. However, in the case of a strong infecting dose of a new strain, it is certain that immunity is not sufficient. In our case, if the contaminated air enters only through small leaks in the building envelope, this leads to think that the infecting dose inside the building will be weaker than for a similar aerosol exposure on a farm without an air filtration system. Of course, these hypotheses remain to be validated scientifically.
    - It would be interesting to quantify the PRRS virus concentration in the air outside a filtered building located in an area at risk (at a time when the presence of the virus in the outside air is highly suspected) and, during the same period, to take samples near the locations where leaks are identified. Then we could appreciate the difference of infecting dose, when applicable.
    - Further research would be required to gather more information on the minimum infecting dose for a naïve animal as compared with an animal immunized and exposed to a heterologous strain (the same as that used for the naïve animal) so as to confirm the theory that immunized animals are less sensitive.
- Finally, a drawback of this approach comes from the complexity induced for the PRRS status confirmation for piglets from the immunized farm vs. those from the naive farm.

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Assessment of Biosecurity and Risks of PRRSV Contamination of Canadian Farms with Air Filtration Systems

In order to assess the biosecurity and risks of contamination and spread of the PRRS virus (PRRSV) for Canadian farms covered by this project, an analysis with the PADRAP tool was performed. The Production Animal Disease Risk Assessment Program (PADRAP) is an expert system that is comprised of several tools (a questionnaire, analysis software and a database that can be accessed through Internet) to identify on the farm the key factors to be controlled in order to reduce the risks of introducing and spreading the PRRSV and, consequently, to detect possibilities for improvement of protocols. The analysis performed and described in this report includes information on a group of thirteen farms with air filtration systems that took part in the project.

Results of the PADRAP Analysis

Index of internal and external risks of transmitting the PRRS virus based on PADRAP scores

The data presented in Figure 1 show the positioning of each farm's average score for internal risks (X-axis) and external risks (Y-axis).

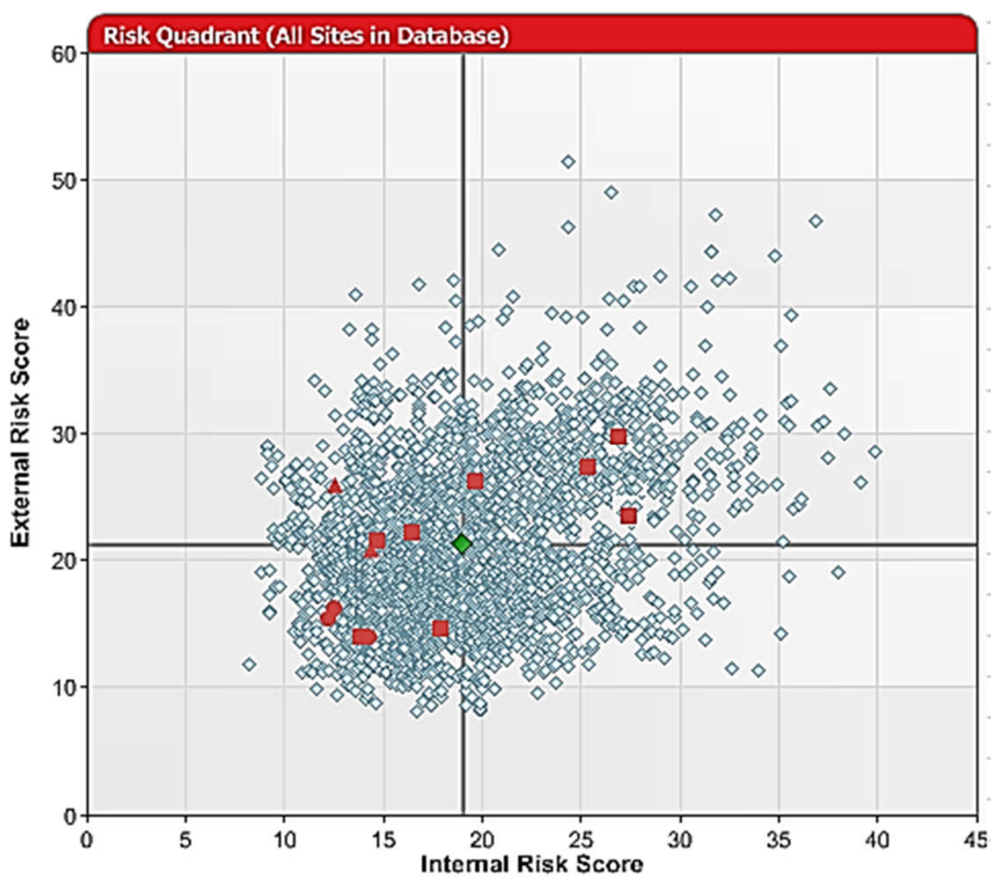

Figure 1 **Grouping of dots representing the internal and external risk index scores. Red squares represent farrowing barns, red circles boar studs, and red triangles quarantine facilities.**

Each red dot represents a farm that was evaluated as part of the present project. Each blue dot represents an evaluated farm that is included in the PADRAP global database. This diagram demonstrates that more than half (7/13, 53.85%) of the farms are located in the best quadrant (quadrant A: low internal and external risks), while (4/13, 30.77%) of the farms are located in the high internal and external risk quadrant (quadrant D).

The majority of farms (4/7) located in quadrant A present low risks due to their type of production, i.e., three sites are boar studs and one is a quarantine facility. These types of production do not manage the risk related to semen introduction, which considerably reduces risk scores. The two farms located in quadrant B can improve biosecurity measures related to external risks in order to reduce their scores and to be able to reposition themselves in quadrant A.

The four farms located in quadrant D should improve some strategic measures in their biosecurity protocols so as to reduce the internal and external risks of PRRSV transmission. For each farm that had a high risk score, a list of biosecurity measures to be improved was generated from the PADRAP and should be assessed by the veterinarian and the farm producer so that appropriate action is taken to reduce the score and to be able to bring these farms into the low-risk quadrant. Despite the required improvements, one can notice that the scores achieved are not the highest in the PADRAP global database.

Grouping of Results Based on the Calculation of a Composite Index Demonstrating the Impact of Risks

Table 1 and Figure 2 show the risk factor categories in descending order based on the score of a composite index calculated from the central tendency (mean), the variance (high-risk factor frequencies, %) and the number of factors per questionnaire category.

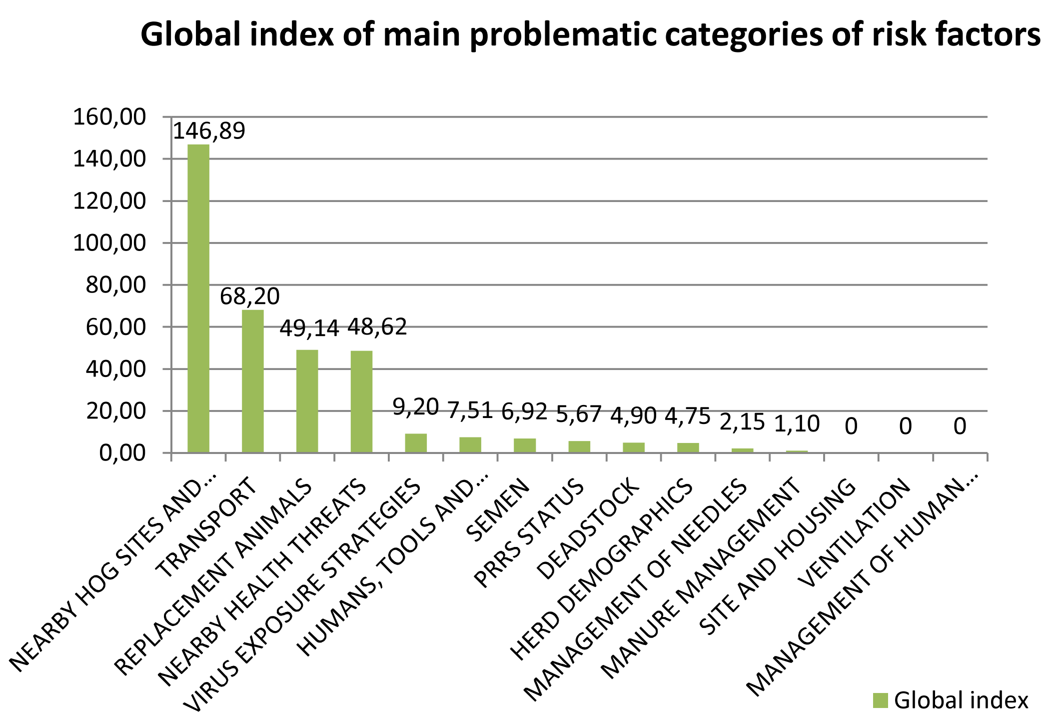

Figure 2 Main categories (composite index)

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Table 1 Risk factor categories based on the global index

Risk factor categories	Number of risk factors per category*	Mean of the group of farms per risk factor category**	% of responses associated with the highest risk, distributed by categories***	Composite index[1]
Nearby Swine sites and roads	23	26.63	23.98	146.89
Transportation	30	15.7	14.48	68.20
Replacement animals	17	23.23	12.44	49.14
Nearby health threats	10	35.82	13.57	48.62
Virus exposure strategies	12	11.69	6.56	9.20
Humans, tools and other vectors	12	11.06	5.66	7.51
Semen	19	8.47	4.30	6.92
PRRS status	11	11.99	4.30	5.67
Dead animals	6	20.06	4.07	4.90
Herd demography	4	26.25	4.52	4.75
Needle management	2	33.98	3.17	2.15
Manure management	2	18.69	2.94	1.10
Site and housing	2	9.07	0	0
Environment and ventilation	3	8.79	0	0
Human resource management	2	6.53	0	0

1 Composite index calculated by multiplying the three columns on the left.
* Number of questions in each risk category.
** Mean of the score that evaluates the risk of the group of farms per category.
*** Example: 23.98% of responses associated with risks considered to be the highest belong to the "Nearby swine sites and surrounding roads" category.

The classification of risk categories from the calculation of the composite index suggests that the four main biosecurity problems in the group of farms with air filtration systems are: 1) Nearby swine sites and roads 2) transportation, 3) replacement animals and 4) Nearby health threats. One must take into account that classifications depend on the score of the expert system for each question. Such scores are subjective and, hence, the results cannot be interpreted linearly (a score two or five times higher does not necessarily mean that a real risk is two or five times higher).

In order to improve the first and fourth categories, the use of air filters can be a solution to artificially isolate swine sites from surrounding sites. Since the farms evaluated as part of this project already have filters, one could consider that these risk factors are significantly reduced. Such risks might also be addressed through a regional approach to improve the biosecurity protocols for all farms in the areas where farms with air filtration systems that took part in the study are located. This might contribute to reduce the risks of contamination and spread of the PRRS virus with relation to the high density of farms in the area and their health status.

The management of replacement animals is an item related to many solutions and should be solved by the producer based on veterinarian's recommendations.

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Detailed Analysis of Main Risks

In this section, we will analyze the questions of the main risk categories identified in the section above, namely: 1) Nearby swine sites and roads, 2) transportation, 3) replacement animals and 4) Nearby health threats.

In the following tables, risk factors are listed in descending order based on the number of farms that obtained responses whose weighting is higher than 22 points (high-risk category).

Nearby Swine Sites and Roads

Research has scientifically demonstrated that the virus can be transmitted through the air to a distance of 5.65 miles (9.1 km). The number of surrounding swine sites represents a health risk for a farm. The maximum number of sites suggested according to the PADRAP in a 1 to 3 mile (1.6 to 4.8 km) radius is equal to or higher than 5. The majority of farms (11/13, 84.62%) considered in this study are surrounded by at least 5 sites, which represents the number of sites whose weighting corresponds to the highest risk. In a 3 to 5 mile radius, more than 6 sites represents the highest risk. The majority of farms (9/13, 69.23%) achieved a moderately high score with 1 to 5 sites in a 3 to 5 mile (4.8 to 8.0 km) radius.

The majority of farms (10/13, 76.92%) considered in the study have finishers housed on the closest swine farm. This type of production has a higher risk of contaminating neighbours than the other types of production.

The semen for the majority of farms (10/13, 61.53%) comes from a site in the vicinity of other swine farms in a 1 to 3 mile (1.6 to 4.8 km) radius. The number of sites located in the vicinity amounts to more than four. The number of swine farm sites located in a 3 to 5 mile (4.8 to 8.0 km) radius from the site(s) from which the semen originates amounts to more than three in 61.53% of farms (8/13 sites).

Currently, artificial insemination centres have positive-pressure air filtration systems. The PADRAP considers the fact of having swine sites in an 8 km radius around artificial insemination centres as being a high risk, but according to this study we consider that this risk is over-estimated since the air filtration system allows controlling it adequately.

Should a PRRS contamination originate from an artificial insemination centre, the source of contamination would be detected quickly since all artificial insemination centres are currently PRRS naïve. The other probable causes of contamination like, for example, transportation, are more difficult to confirm.

Another significant risk factor of the “Nearby Swine sites and roads” category is the flat topography where 61.53% of the sites (8/13) are located.

Table 2 Distribution of scores (>22 = high risks and ≤ 22 low risks) for risk factors of the "Nearby Swine sites and roads" category

Risk factor: Nearby Swine sites and roads	>22	≤22	Total of farms
Pig density (swine sites) in a 1 to 3 mile (1.6 to 4.8 km) radius from this site	11	2	13
Finishers housed on the closest swine farm	10	3	13
Proximity of sites from which the semen originates with relation to other swine farm sites in a 1 to 3 mile (1.6 to 4.8 km) radius	10	3	13
Pig density (swine sites) in a 3 to 5 mile (4.8 to 8.0 km) radius from this site	9	4	13
Number of swine farm sites in a 1 to 3 mile (1.6 to 4.8 km) radius from the site(s) from which the semen originates	8	5	13
Number of swine farm sites in a 3 to 5 mile (4.8 to 8.0 km) radius from the site(s) from which the semen originates	8	5	13
Site topography	8	5	13
Distance (miles) to the closest swine farm	7	6	13
Closest public road carrying significant traffic to the closest markets or collection points	7	6	13
Control of other sites in a 1 to 3 mile (1.6 to 4.8 km) radius from the site(s) from which the semen originates	6	7	13
Distance (miles) to the closest public road with heavy transportation of animals	6	7	13
Proximity of sites from which the semen originates with relation to other swine farm sites in a 3 to 5 mile (4.8 to 8.0 km) radius	6	7	13
Pig density (swine sites) within a 1 mile (1.6 km) radius from this site	4	9	13
Nursery pigs housed at nearest swine farm	3	10	13
Distance (miles) to the closest swine market or collection point	2	11	13
Closest public road carrying significant traffic to the closest location where vehicles are cleaned	1	12	13
Boar stud housed at nearest swine farm	0	13	13
Breeding females and suckling piglets housed at nearest swine farm	0	13	13
Control of other swine farm sites in a 3 to 5 mile (4.8 to 8.0 km) radius from the site(s) from which the semen originates	0	13	13
Control of other swine farm sites within a 1 mile (1.6 km) radius from the site(s) from which the semen originates	0	13	13
Number of swine farm sites within a 1 mile (1.6 km) radius from the site(s) from which the semen originates	0	13	13
Proximity of sites from which the semen originates with relation to other swine farm sites within a 1 mile (1.6 km) radius	0	13	13
Replacement breeding animals housed at nearest swine farm	0	13	13
Total	**106**	**193**	**299**

Transportation

The second category that has a significant impact on the risks of PRRSV transmission on farms participating in this project is transportation. Even though it does not appear to be one of the major ones in the table with the mean risks for the area of the group of farms with air filtration systems, it appears, however, in the other tables of problematic categories. This is explained by noting that some very important biosecurity protocols are not applied in the majority of farms (road restrictions), whereas other protocols are closely followed (cleaning and drying of trucks, compliance with health pyramids): therefore, the latter reduce the final mean of this risk factor category on the collective results of the project. This distribution is said to be "bimodal."

Table 3 shows the factors related to the management of transportation. The response from each farm is included in the high-risk category (weighting higher than 22 points) and the low-risk category (weighting lower than 22 points).

Road restrictions

The majority of evaluated farms (10/13, 76.92%) do not have specific, predefined routes for the transportation of swines to avoid using roads on which swine sites are located. Planning a route would be best to avoid roads on which there is a significant traffic of swines, especially when swines are transported to a slaughter house. The operating restrictions of vehicles used for transporting animals to markets or collection points also increase the risk scores due to the fact that 76.92% of the farms use vehicles that can carry animals to the slaughter house, to move "genetic" or "non-genetic" animals to other sites in the production system.

Table 3 Distribution of scores (>22 = high risks and ≤ 22 low risks) for risk factors of the "Transportation" category

Risk factor: Transportation	>22	≤22	Total of farms
Road restrictions for vehicles used for transporting animals to markets and collection points	10	3	13
Road restrictions for vehicles used for transporting "non-genetic" animals to and from other sites in the production system	10	3	13
Restrictions pertaining to the transportation of different types of pigs in vehicles for transporting animals to markets and collection points	10	3	13
Restrictions pertaining to the transportation of different types of pigs in vehicles for transporting "non-genetic" animals to and from other sites in the same production system	6	7	13
Cabin disinfection between sites for vehicles transporting animals to markets and collection points	5	8	13
Road restrictions for vehicles used for transporting "genetic" animals	5	8	13
Flow of feed trucks	4	9	13
Use of a disinfectant on vehicles transporting "genetic" animals	3	10	13
Use restrictions on vehicles used for transporting "genetic" animals	3	10	13
Transit restrictions for vehicles transporting "genetic" animals	2	11	13
Type of load out area	2	11	13

Risk factor: Transportation	>22	≤22	Total of farms
Water pre-rinsing for removing organic materials released before the cleaning of vehicles used for transporting animals to markets and collection points	1	12	13
Water pre-rinsing for removing organic materials released before the cleaning of vehicles used for transporting “genetic” animals	1	12	13
Restrictions pertaining to the movements of drivers of vehicles transporting animals to markets and collection points	1	12	13
Washing frequency of vehicles transporting “genetic” animals	1	12	13
Restrictions pertaining to the clothing of drivers, between sites, of vehicles transporting animals to markets and collection points	0	13	13
Cabin cleaning, between sites, for vehicles transporting animals to markets and collection points	0	13	13
Use of a disinfectant on vehicles transporting animals to markets and collection points	0	13	13
Use of a disinfectant on vehicles transporting “non-genetic” animals to and from other sites in the same production system	0	13	13
Drying time following wash of vehicles transporting animals to markets and collection points	0	13	13
Drying time following wash of vehicles transporting “genetic” animals	0	13	13
Drying time following wash of vehicles transporting “non-genetic” animals to and from other sites in the same production system	0	13	13
Restrictions pertaining to the transportation of animals with different types of PRRS statuses for vehicles used for transporting animals to markets and collection points	0	13	13
Restrictions pertaining to the transportation of animals with different types of PRRS statuses for vehicles used for transporting “genetic” animals	0	13	13
Restrictions pertaining to the transportation of animals with different types of PRRS statuses for vehicles used for transporting “non-genetic” animals to and from other sites in the same production system	0	13	13
Water pre-rinsing for removing organic materials released before the cleaning of vehicles used for transporting “non-genetic” animals to and from other sites in the same production system	0	13	13
Transit restrictions for vehicles transporting animals to markets and collection points	0	13	13
Transit restrictions for vehicles transporting “non-genetic” animals to and from other sites in the same production system	0	13	13
Washing frequency of vehicles transporting animals to markets and collection points	0	13	13
Washing frequency of vehicles transporting “non-genetic” animals to and from other sites in the same production system	0	13	13
Total	64	326	390

Replacement Animals

The management of replacement animals is a critical factor in efforts to achieve a steady negative or positive population with regards to the PRRS virus. The gilt acclimation and isolation protocol (blood tests, etc.) is essential to be able to reduce the risk of contamination and spread of the PRRSV in gilts and the breeding herd.

Table 4 shows the factors related to the management of replacements animals. The response from each farm is included in the high-risk category (weighting higher than 22 points) and the low-risk category (weighting lower than 22 points).

Table 4 Distribution of scores (>22 = high risks and ≤ 22 low risks) for risk factors of the "Replacement animals" category

Risk factor: Replacement animals	>22	≤22	Total of farms
Isolation/acclimation period (number of days)	9	4	13
Number of sites, from which the replacement animals of the farm's sows originate (those that produce replacement animals for this site), that have already completed the PADRAP questionnaire	8	5	13
Delivery frequency of replacement animals in the breeding herd of this site (days between deliveries)	6	7	13
Number of replacement animal supply sites	6	7	13
Number of sites where replacement animals originate in the past two years	5	8	13
PRRSV status of replacement females in isolation/ acclimation	4	9	13
Location where replacement animals in acclimation for this site are housed	3	10	13
Acclimation flow of replacement animals (e.g., all-in/all-out, or continuous flow)	3	10	13
Response when the group of replacement animals in isolation/acclimation becomes PRRSV positive through PCR or ELISA from natural field virus exposure	3	10	13
Location where replacement animals in isolation for this site are housed	2	11	13
Serum evaluation of replacement animals for the PRRSV or antibodies through PCR or ELISA at the exit of the isolation/acclimation site	2	11	13
PRRSV seroconversion time of replacement animals for breeding prior to their entry into the breeding herd	2	11	13
Isolation flow of replacement animals (e.g., all-in/all-out, or continuous flow)	1	12	13
Serum evaluation of replacement animals for the PRRSV or antibodies through PCR or ELISA at the entry of the isolation/acclimation site	1	12	13
PRRSV status of breeding herds from which replacement animals originate	0	13	13
PRRS viral status prior to isolation/acclimation or entry into the breeding herd, of nurseries and finishers from which replacement animals originate	0	13	13
Typical PRRSV status of replacement animals for breeding at their entry into the breeding herd (% positive according to ELISA)	0	13	13
Total	55	166	221

The majority of farms (9/13, 69.23%) have an isolation/acclimation period of less than 60 days. The PADRAP recommends ideally more than 120 days. In the case of farms that remain negative or naïve and have no acclimation, the duration of the isolation is probably a lower risk.

The sites that supply replacement animals to the farms evaluated as part of this project have not been assessed yet by the PADRAP. The PADRAP managers consider that the more sites are evaluated using this tool, the more site managers will be aware of risk factors that threaten their farms and the better they will be prepared to reduce the risks of contamination and spread of the PRRSV. This argument especially applies to sites from which replacement animals originate, as these sites should always be PRRS free since they supply other ones.

However, in Canada, the majority of farms with air filtration systems are supplied by PRRS-negative farms. Most genetic suppliers have structured PRRS monitoring programs that ensure efficient control of contamination risks.

As for the risk related to the location where replacement animals in isolation/acclimation are housed, the farms that have integrated isolation facilities have high risk scores. In the case of farms with air filtration systems, we consider that this risk of contamination is adequately controlled.

Health Threats in the Vicinity

Table 5 shows the factors related to nearby health threats. The response from each farm is included in the high-risk category (weighting higher than 22 points) and the low-risk category (weighting lower than 22 points).

Table 5 Distribution of scores (>22 = high risks and ≤ 22 low risks) for risk factors of the "Health threats in the vicinity" category

Risk factor: Health threats in the vicinity	>22	≤22	Total of farms
Finishing pigs housed on the closest PRRSV-positive farm	11	2	13
Breeding females and suckling piglets housed on the closest PRRSV-positive farm	10	3	13
PRRSV status of other swinefarms sites within a 1 to 3 mile (1.6 to 4.8 km) radius from the site(s) from which the semen originates	8	5	13
Replacement breeding animals housed on the closest PRRSV-positive farm	8	5	13
Stability of the closest PRRSV-positive farm	8	5	13
Nursery pigs housed on the closest PRRSV-positive farm	7	6	13
Distance (miles) to the closest PRRSV-positive farm	6	7	13
PRRSV status of other swine farm sites within a 3 to 5 mile (4.8 to 8.0 km) radius from the site(s) from which the semen originates	1	12	13
PRRSV status of other swine farm sites in a 1 mile radius from the site(s) from which the semen originates	1	12	13
Boar stud housed on the closest PRRSV-positive farm	0	13	13
Total	60	70	130

Analysis of Findings and Recommendations to Minimize Risks of Contamination in Canadian Buildings with Air Filtration Systems

The vast majority of farms assessed in the project (11/13, 84.61%) have a surrounding farm that houses PRRSV-positive finishers, which represents a very high risk of contamination. According to the PADRAP weighting criterion, the presence of replacement animals, breeding females , suckling piglets and nursery piglets represents a high risk, although lower than that caused by finishers with a positive viral status. In this study, we consider that all types of pigs with a positive PRRS status represent a high risk.

In addition, 61.54% (8/13) of farms have a positive surrounding site that has experienced a health instability caused by the PRRSV in a recent period (last three months).

The semen suppliers of 61.54% (8/13) of the farms of the group have a PRRS-positive site in a 1 to 3 mile (1.6 to 4.8 km) radius. A positive element is that the majority of surrounding sites in a one mile radius and in a 3 to 5 mile radius from the sites from which the semen of the vast majority of farms in the project originates (12/13, 92.31%) are not currently PRRS-positive, which reduces the risks of contamination of semen suppliers.

Artificial insemination centres have positive-pressure air filtration systems. We consider that the risk of aerosol contamination by surrounding sites with a positive status is over-estimated since the air filtration system allows controlling it adequately.

The main four problematic risk factor categories have been identified and the analysis helped provide a general overview of the biosecurity status for the group of farms assessed.

One should not just focus on problems encountered, but one should also develop action plans to improve biosecurity protocols so as to reduce the risks of contamination and spread of the PRRS virus. Follow-up of the application of the action plans is recommended.

Analysis of Findings and Recommendations to Minimize Risks of Contamination in Canadian Buildings with Air Filtration Systems

Highlights

- The health protection of farms with air filtration systems is not optimal; work remains to be done to reduce the risks of contamination;
- Canadian producers who own buildings with air filtration systems must be more rigorous in the application of the biosecurity protocol and the operation of their buildings with air filtration systems;
- According to the PADRAP analysis, half of the farms position themselves in the best risk quadrant, i.e., low external and internal risks. The other half of the farms position themselves in the quadrants indicating that there is room for improvement in the biosecurity protocols and performances can be improved as regards the risk of contamination of these buildings;
- Producers must be better informed about the operation of buildings with air filtration systems both regarding biosecurity and air ventilation and filtration equipment;
- The way to install filters and to make buildings airtight has been improved on more recent installations, but some older installations must be corrected;
- It is important to conduct regular audits in order to detect problems as regards biosecurity and/or the equipment and the building;
- Considering the current risks of contamination, it is necessary to find new ways to reduce installation and operation costs so as to reduce the financial risk;
- Negative-pressure filtration systems can be improved, but there will always be a risk associated with this type of system;
- Concepts must be developed for existing and new positive-pressure buildings, but at affordable costs.

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June 2013

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Legal Deposit - 2013
Bibliothèque et Archives nationales du Québec
Library and Archives Canada
ISBN 978-2-922276-88-6

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Acknowlegements

A portion of funding for this project was provided by the sector councils of Quebec, Ontario, Alberta, Manitoba and Saskatchewan, who administer the Canadian Agricultural Adaptation Program (CAAP) for Agriculture and Agri-Food Canada. This study was also funded by the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ), under Section 3 of the Programme d'appui financier pour un secteur agroalimentaire innovateur, the Canadian Swine Health Board (CSHB), R.Robitaille et fils, inc., the Fédération des producteurs de porcs du Québec (FPPQ), Ontario Pork, Manitoba Pork, the Saskatchewan Pork Development Board (Sask Pork), Alberta Pork, the Centre de recherche de l'Institut universitaire de cardiologie et de pneumologie de Québec (CRIUCPQ) affiliated with Université Laval, JSR Genetics (Canada Ltd.), the Prairie Swine Centre Inc. (PSCI) and the Centre de développement du porc du Québec inc. (CDPQ).

Funding for this project has been provided in part through the Canadian Agricultural Adaptation Program (CAAP) on behalf of Agriculture and Agri-Food Canada. In Quebec, the portion intended for the agricultural-production sector is being managed by the Conseil pour le développement de l'agriculture du Québec (CDAQ).