Preventive Veterinary Medicine 104 (2012) 74–83

Contents lists available at SciVerse ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Epidemiological investigations in regard to porcine reproductive and respiratory syndrome (PRRS) in Quebec, Canada. Part 1: Biosecurity practices and their geographical distribution in two areas of different swine density

Marie-Ève Lambert[a,*], Zvonimir Poljak[b], Julie Arsenault[a], Sylvie D'Allaire[a]

[a] Faculty of Veterinary Medicine, Université de Montréal, St. Hyacinthe, Quebec, Canada
[b] Department of Population Medicine, Ontario Veterinary College, University of Guelph, Ontario, Canada

ARTICLE INFO

Article history:
Received 9 March 2011
Received in revised form 3 December 2011
Accepted 5 December 2011

Keywords:
Biosecurity
Pigs
Porcine reproductive and respiratory syndrome
PRRS
Spatial

ABSTRACT

Porcine reproductive and respiratory syndrome virus (PRRSV) is a considerable threat to the swine industry and implementing biosecurity measures is essential for the control of its transmission. The aims of this study were: (1) to describe biosecurity practices in production sites located in a moderate density (MD) and a high density (HD) pig area according to production type; (2) to group sites in different patterns according to their biosecurity practices; and (3) to determine the geographical distribution of sites according to biosecurity patterns. Biosecurity practices were selected based on PRRS epidemiology. A questionnaire was completed on 125 breeding sites (MD = 54; HD = 71) and 120 growing (HD) sites, between 2005 and 2008. Depending on area and production type, the frequency of biosecurity practices used ranged from 0 to 2% for barrier at site entrance, 0 to 19% for use of shower, 25 to 35% for washing truck between loads of pigs, 51 to 57% for absence of rendering or rendering without access to the site, and 26 to 51% for absence of gilt purchase or purchase with quarantine. Better practices pertaining to entrance protocol (i.e. "no-entry" sign, shower, ≥24 h downtime) were reported more frequently on breeding sites in the MD than the HD area ($P < 0.05$). In the HD area, growing sites had in general a lower level of biosecurity than breeding sites. Using a two-step clustering procedure performed separately for breeding and growing sites, two different patterns were obtained for each production type, which corresponded to a high and low level of biosecurity. For breeding sites, a higher biosecurity level was observed at sites located away from other pig sites, set at more than 300 m from the public road, having higher sow inventory, or being part of an integrated production ($P < 0.05$). Spatial clusters of sites for each biosecurity pattern were detected. This study identified some shortcomings regarding biosecurity that should be addressed before implementing any PRRSV regional control. Vicinity of sites with different biosecurity levels also suggests difficulties in planning priorities of intervention based on geographical distribution of sites.

* Corresponding author. Tel.: +1 450 773 8521x8473; fax: +1 450 778 8120.
E-mail address: marie-eve.lambert@umontreal.ca (M.-È. Lambert).

0167-5877/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.prevetmed.2011.12.004

1. Introduction

Porcine reproductive and respiratory syndrome (PRRS) is a viral disease that has a major economic impact on the swine industry (Neumann et al., 2005). PRRS virus (PRRSV) causes late-term abortions and stillbirths, mummified or weak piglets in breeding phases and it also induces respiratory problems, impairs growth performance and increases mortality in weaner-finisher phases (Christianson and Joo, 1994). Several direct and indirect pathways are likely involved in transmission of PRRSV between herds, including the introduction of infected animals or semen, transport vehicles, aerosols, flying insects, waterfowl and fomites (Le Potier et al., 1997; Zimmerman et al., 1997; Dee et al., 2002, 2004b, 2009; Mortensen et al., 2002; Otake et al., 2002, 2004).

In Quebec, approximately 7 million pigs are slaughtered annually. Two thirds of swine production is concentrated in three administrative regions (Monteregie, Centre-du-Quebec, Chaudiere-Appalaches). The high density of production in these regions and proximity with neighbouring pig sites make the swine industry particularly vulnerable to transmission of PRRSV or other respiratory diseases (Stärk et al., 1992; Flori et al., 1995; Mortensen et al., 2002; Holtkamp et al., 2010). This can facilitate area spread of PRRSV through limited-distance mechanisms (e.g. aerosols, flying insects, etc.) or through an increased frequency of indirect contact via vehicles or people involved in the swine industry (Ribbens et al., 2009). In Quebec, these movements are further increased by a multi-site production system, a structure introduced 20 years ago to facilitate segregated early weaning strategies. Implemented to limit the transmission of pathogens from sow to piglets, the procedure unfortunately had the effect of increasing movement of pigs between premises, thus ultimately favouring dissemination of some pathogens (D'Allaire, 2000).

Biosecurity is defined as procedures, efforts and programs established to reduce the risk of new disease introduction (external biosecurity) or to slow down the transmission of endemic pathogens into populations (internal biosecurity) (Amass and Clark, 1999; Dargatz et al., 2002; Barrington et al., 2006; Gunn et al., 2008). Very few field studies have been conducted to evaluate associations between specific biosecurity practices on the farm and PRRSV health status (Mortensen et al., 2002; Evans et al., 2008, 2010; Holtkamp et al., 2010). However, the risk of PRRSV introduction on a production site is likely to be influenced by these measures, since mechanical transmission of PRRSV has been shown experimentally to occur through pig transportation or through fomites carried by people entering the unit (Dee et al., 2002, 2004a,b, 2007). Consequently, the success of PRRSV control is likely to depend on biosecurity implementation. Likewise, knowledge of the current biosecurity measures is essential in order to target priorities for the industry in terms of improving practices or to evaluate efforts needed before implementing a PRRSV regional control program.

The aims of this study were: (1) to describe biosecurity practices according to production type in sites located in two geographical areas of different swine density; (2) to group sites into patterns according to their biosecurity practices; and (3) to determine the geographical distribution of sites according to biosecurity.

2. Materials and methods

2.1. Study design and source population

As part of a larger study on the transmission and control of PRRSV, we conducted a cross-sectional study to describe biosecurity practices in sites located in two regions of Quebec between May 2005 and August 2008. A high density (HD) area was selected, which corresponded to 10 adjacent municipalities with a density of 354 pigs/km^2 (Ministère de l'Agriculture des Pêcheries et de l'Alimentation du Québec; MAPAQ, 2010), located in the Monteregie administrative region, where all types of production were included. A moderate density (MD) area with 44 pigs/km^2 (Ministère de l'Agriculture des Pêcheries et de l'Alimentation du Québec; MAPAQ, 2010) was also selected, corresponding to the Estrie region of Quebec, in which only sites housing sows were included in our source population. This entire region was selected in order to obtain a comparable number of breeding sites in both areas. Weaners and finishers were not included in this latter area due to limited resources available for the study.

The unit of interest was the production site, defined as one or more barns located within 300 m of each other, belonging to the same owner (individual or corporate) and having the same animal source(s). In order to select sites, all producers listed in the Quebec Federation of Pork Producers (FPPQ) database and included in the source population were contacted. A written description of the project and a participation form to be signed and returned were initially sent to producers; participation was on a voluntary basis. In the absence of a response or with a refusal, producers were contacted by phone to seek their participation or to inquire into the reasons for the refusal.

2.2. Questionnaire

A questionnaire with mainly semi-closed questions was developed to assess potential risk factors previously mentioned in the literature for introduction of PRRSV on a production site. Four veterinarians specialized in swine production and three producers were consulted to assess relevance, clarity and completeness of questions. The questionnaire was filled out by the first author during a 45 min in-person interview with the owners of independent farms or with employees for farms under contract. When it was impossible to perform in-person interview (mainly because the producer was not available on the site), the questionnaire was completed during a phone interview. Information was gathered on type of production, ownership, pig inventory, pig flow, distance from the public road and the closest pig site (approximated by the producer) (Table 1). Geographical coordinates of the site (latitude/longitude) were obtained using a global positioning system (GPS). Data were also obtained on specific external biosecurity measures that can be implemented on the site by the producer which covered about