Assessing pig farm biosecurity measures for the control of Salmonella on European farms

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Background
Salmonella spp. is the second most common zoonotic pathogen in the European Union, causing gastrointestinal infections in people. Although poultry (and eggs) are typically identified as the most common source of zoonotic Salmonella infection in Europe, pigs are the second most common source. Controlling and limiting Salmonella on pig farms is deemed important for reducing the risk of zoonotic transmission, alongside proper slaughterhouse practices. Although farm biosecurity is believed to be important for controlling Salmonella transmission on farm, robust evidence is lacking on which specific measures are most effective. The aim of the study was to assess the use and effectiveness of biosecurity measures for the control of Salmonella on European commercial pig farms.

Materials and Methods
This study enrolled 250 pig farms across nine European countries (18-38 per country). Each country recruited commercial-sized breeder, farrow-to-finish and finisher farms, excluding small-holdings, nucleus/multiplier, and Specific Pathogen Free herds. From each farm, 20 pooled faecal samples were collected from the floor of pig housing, each consisting of ten pinches of faeces, and analysed for Salmonella presence. Salmonella isolation was carried out in accordance with ISO 6579-1:2017. Based on the proportion of positive results, farms were categorised as at higher or lower Salmonella risk (20% sample prevalence cut-off) and associations with variables from a comprehensive questionnaire were investigated. Two countries provided surveillance data on the occurrence of Salmonella in the pig herds for risk categorisation rather than the pooled faecal samples. Multivariable regression analysis was used to determine significant associations to biosecurity practices to identify those effective for Salmonella control. Principal components analysis (PCA) was used to assess the sources of variation between farms, and correlation between measures.
Results: Of the farm population, 120 (48.0%) were farrow-to-finish, 47 (18.8%) breeding, and 83 (33.2%) fattening farms. A total of 41 (16.4%) farms were identified as being at higher risk for Salmonella. The most commonly applied biosecurity practices were: presence of a pest control program (94.7%), carcase storage protected against wildlife (91.6%), use of disposable gloves to manipulate carcasses (82.5%), and external and internal persons using farm-specific footwear (82.3%

and 84.4%, respectively). The multivariable modelling results indicated that farms were less likely to be in the higher risk category if they had '<400 sows'; used rodent baits close to pig enclosures; isolated stay-behind (sick) pigs; did not answer that the hygiene lock/ anteroom was easy to clean; did not have a full perimeter fence; did apply downtime of at least three days between farrowing batches; and had fully slatted flooring in all fattener buildings.

PCA was completed on those variables which were P-value<0.25 at the univariable screening stage. This produced 99 PCs, with nine PCs having an eigenvalue above two and these explained 60% of the total variation. When these nine PCs were added as explanatory variables into a single multivariable logistic regression model for the Salmonella higher risk outcome, then three were found to be statistically significant (PC1, PC3 and PC6). Each of the three significant PC's included small amounts of variance from a large number of explanatory variables. However, PC1 was mainly representing six variables related to breeding farms, such as source of semen and use of all-in/ all-out management of the farrowing area. PC3 was mainly representing sourcing of pigs, such as whether breeding pigs came from one or multiple sources within a year and presence of a quarantine area. PC6 covered a wider range of topics, including water source, flooring type and wild bird control. The overall PCA results suggest that the use of rodent baiting points and the fattener flooring types identified in the multivariable model may have had a degree of correlation on the farms in which they were present, whereas the other variables were not likely to be correlated.

Conclusion

The study results suggest some simple control measures that could be prioritised on European pig farms to help control Salmonella. This study formed part of the BIOPIGEE project "Biosecurity practices for pig farming across Europe", funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 773830. For more detailed information, please read the published manuscript.