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

Richard P Smith, Hannah E May, Elke Burow, Marina Meester, Tijs J Tobias, Elena-Lucia Sassu, Enrico Pavoni, Ilaria Di Bartolo, Christopher Prigge, Dariusz Wasyl, Jacek Zmudzki, Arvo Viltrop, Imbi Nurmoja, Veit Zoche-Golob, Giovanni L Alborali, Romina Romantini, Arkadiusz Dors, Gergana Krumova-Valcheva, Ivana Koláčková, Guiseppe Aprea, Hristo Daskalov

Key Findings:

- A cross-sectional study was performed on 250 farms from nine European countries to identify key biosecurity measures for controlling Salmonella in pig farms.
- Lower *Salmonella* risk farms were associated with fewer sows, using rodent baits, isolating sick pigs, maintaining proper hygiene practices, implementing downtime between batches, and utilizing fully slatted flooring in fattener buildings.

Introduction

Salmonella spp. is a common zoonotic pathogen, causing gastrointestinal infections in people. Pigs and pig meat are a major source of infection. Although farm biosecurity is believed to be important for controlling *Salmonella* transmission, robust evidence is lacking on which measures are most effective. This study aimed to conduct a structured and comprehensive European-wide risk factor analysis for the identification of farm biosecurity measures that are relevant for limiting the probability of introduction and transmission of *Salmonella* within pig farms.

Material & Methods

A cross-sectional study was performed on 250 farms from nine European countries between January 2020 and November 2021. From each farm, 20 pooled fecal samples were collected and analyzed for *Salmonella* presence. Based on the proportion of positive results, farms were categorized as at higher or lower *Salmonella* risk, and associations with variables from a comprehensive questionnaire were investigated. Multivariable analysis using a forwards-stepwise logistic model, was used to evaluate the associations between the binary *Salmonella* risk status and the exposure variables of interest.

Results

A total of 250 questionnaires were received from farms that had corresponding *Salmonella* results, with between 18 and 38 questionnaires received from farms in each of the nine European countries. Most farms were either farrow-to-finish (46.0%) or fattener farms (31.2%). A total of 199 farms were sampled specifically for this study. From the 199 farms, *Salmonella* was detected in pooled fresh faces from 69 farms (34.7%). Results by farm type showed that farrow-to-finish farms had, on average, a significantly lower number of samples positive for *Salmonella* (5.8%, compared to 9.3% for breeding farms and 9.7% for fattener farms; Chi-squared $p < 0.001$).

Multivariable analysis results in table 1 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 3 days between farrowing batches; and had fully slatted flooring in all fattener buildings.

Table 1. Results of multivariable logistic regression of *Salmonella* risk categorization on pig farms

Variable	Category	Higher risk	Lower risk	% Higher risk	Odds ratio	95% Confidence interval Lower	95% Confidence interval Upper
No. of sows	0	18	47	27.7	1.000		
	<400	4	81	4.7	0.099	0.026	0.371
	401–1000	7	30	18.9	0.686	0.184	2.558
	1000+	4	19	17.4	1.407	0.278	7.124
	Not known	8	32	20.0	0.539	0.165	1.757
Are rodent baits used in the surroundings of the farm enclosures?	No	18	45	28.6	1.000		
	Yes	22	147	13.0	0.265	0.105	0.668
	NA	1	17	5.6	0.151	0.013	1.778
Are stay-behinds always isolated from the healthy ones (in physically separated hospital area / or by euthanasia)?	No	19	55	25.7	1.000		
	Yes	21	147	12.5	0.280	0.112	0.700
	N/A	1	6	14.3	0.338	0.030	3.815
Is the floor in each anteroom / hygiene lock even / without damages and thereby easy to clean and to disinfect?	Yes	37	164	18.4	1.000		
	No	4	45	8.2	0.156	0.040	0.601
Are all farm buildings/ fields surrounded by a perimeter fence?	Single or double fenced	31	123	20.1	1.000		
	No	9	64	12.3	0.191	0.062	0.589
	Partly interrupted	1	22	4.3	0.093	0.010	0.853
Which standard cleaning and disinfection procedures are used in the farrowing barns between batches? – Downtime (at least 3 days)	No	34	130	20.7	1.000		
	Yes	7	79	8.1	0.252	0.079	0.803
What kind of flooring system is in the barn sections for fatteners?	Any other flooring	23	66	25.8	1.000		
	Only solid floor	3	29	9.4	0.209	0.042	1.047
	Only full slats	9	69	11.5	0.293	0.103	0.833
	Not present/missing	6	45	11.8	0.352	0.102	1.214

Discussion

The study highlights several prioritized biosecurity measures for controlling *Salmonella* on European pig farms. However, recruitment processes may have introduced selection bias, with variations in farm types and regions hindering inter-country comparisons. Participating farms might have been more proactive in *Salmonella* control or already facing issues, potentially leading to observation bias.

The full article is available at: https://doi.org/10.1017/S0950268823001115.