The influence of good farming practice on the occurrence of Salmonella on pig farms

Gotter, V. [1, 2*]
Blaha, T.[2], Koesters, S.[3], Campe, A. [3], Kreienbrock, L.[3], Klein, G.[1]

[1]University of Veterinary MedicineHannover, Foundation, Institute for Food Quality and Food Safety
[2]University of Veterinary MedicineHannover, Foundation, Field Station for Epidemiology
[3]University of Veterinary MedicineHannover, Foundation, Department of Biometry, Epidemiology and Information Processing

*Corresponding author: mailto:verena.gotter@tiho-hannover.de

Abstract

Compliance to good farming practice is a substantial issue to increase animal health and food quality in pork production. In this case-control study, as part of a general framework, farmers were asked six questions via a face-to-face questionnaire, in order to determine their motivation for Salmonella control on their farms. The cases were in the so called Category III (n= 104) of the German Salmonella monitoring system; the controls were in Category I (n = 67). This system is based on the German law to the reduction of Salmonella on pig farms, where farms in Category III have sero-prevalence of > 40% and herds in Category I have a sero-prevalence < 20 %. After a first round of questions based on their motivation, the farms were divided into two groups: those with a "good" and those with a "poor" motivation. A significant difference in motivation between categories could not be determined. As a second step, 16 questions were asked to determine the routine of cleaning and disinfection (C+D-routine). Likewise, two groups were then established. No significant difference in C+D-routine could be established between the categories.

Introduction

Numerous studies concerning risk-factors for Salmonella infectionsin pigs and poultry have been conducted since the 1960s. Many of these studies have illustrated the importance of an efficient cleaning and disinfection routine (Davies and Wray 1995, Davies and Wray 1996, Madec et al. 1999). However, while these studies are meticulous in determining the procedure in use and its efficiency, to the authors' knowledge, none of these studies allow for a judgment of the motivation of the farmer, i.e. it is simply assumed that motivation to reduce the Salmonella prevalence of a herd is high. The objective of this case-control studywas therefore twofold:

1) to verify that farmers are indeed highly motivated to reduce theirSalmonella problem
2) to verify an impact of motivation on the efficiency of a procedure

Although slight differences in motivation and C+D-routine were observed between the two groups, in an overall effect they were not found to be significant.

Material and Methods

Study farms were all located in the north-western part of Germany. Participation was voluntary and any farm taking part in the German Salmonella monitoring, regardless if farrow-to-finish or sole finisher, was applicable. The cases were in the so called Category III (n= 104, high sero-prevalence); the controls were in Category I (n = 67, low sero-prevalence). Each farmer was asked six questions in an interview based questionnaire. They were:

1. Do you consider Salmonella to be a problem on your farm?
2. Do you see a link between your Salmonella-status and your production performance?
3. Have you already implemented measures against Salmonella?
4. Have you planned (further) measures against Salmonella?
5. Do you use your Internet password to check on your Salmonella-status?
6. Were Salmonella detected in faeces samples in the last three months?

The farmers were scored for a "yes" to the individual questions, except for Question 6, where "no" scored (Table 1), and these points were added up to a sum-score. The cut-off for a "good" motivation was set at "7", farms with a lower score were ranged as "poor" motivation (Graph 1).

The farmers were also asked 16 questions concerning their routine of cleaning and disinfection (C+D) of a compartment.

1. Are all animals removed from the compartment?
2. Is the compartment allowed to damp prior to cleaning?
3. Is a high-pressure cleaner utilized?
4. Is warm water utilized?
5. Is a specific cleaner (soap etc.) utilized?
6. Is the compartment rinsed afterwards?
7. Is the compartment left to dry?
8. Is the compartment heated to room temperature before disinfection?
9. Is the solution for disinfection prepared freshly each time?
10. Is the concentration of disinfectant the same as recommended by the company?
11. Does the correct dosage reach the environment?
12. Is the disinfectant listed in the so called DVG-List (i.e. a disinfectant approved by the German Veterinary Medical Society (DVG))?
13. Is the disinfectant allowed to re-act the correct amount of time?
14. Is the amount of disinfectant used correct of the area to be disinfected?
15. Are leftovers from the disinfection removed?
16. Is it documented when and how the compartment was C+D?

The farmers were given scored for a "yes" to the individual questions (Table 2) and the points were added up to a sum-score. The cut-off for a "good" C+D routine was set at 25 points or above, farms with a lower score had a "poor" C+D routine (Graph 2).

The answers were compiled in a database (Microsoft Access 2003) and the statistical analysesdetermining percentages, odds ratios (OR), confidence intervals (CI, set at 95%)and the scores were performed via SAS 9.1 (SAS Institute Inc.).

Results

Table 1 shows the results of the "motivation"-questions.For each Category the amount (N) as well as the percentage (%) of "yes" and "no" answers are given, the cut-off was at "7".

Table 1: Results of the "motivation"-questions

Question	Maximum Score	Answer Category III		Answer Category I	
		N	Yes / No %	N	Yes / No %
1. Problem	2	60 / 44	57.7 / 42.3	6 / 61	9.0 / 91.0
2. Link	1	20 / 82	19.2 / 78.6	29 / 37	43.3 / 55.2
3. Measures 1	1	67 / 37	64.4 / 35.6	35 / 32	52.2 / 47.8
4. Measures 2	2	61 / 43	58.7 / 41.4	11 / 56	16.4 / 83.6
5. Internet	3	41 / 26	61.2 / 38.8	56 / 47	53.9 / 45.2
6. *Salmonella*	2	0 / 103	0.0 / 99.0	2 / 65	3.0 / 97.0

Note: Where the N does not add up to 104 for Category III or to 67 for Category I and the percentage does not add up to 100, information was missing.

Graph 1 shows the results of the "motivation" score, given in percentage. In Category III "good" N = 71, "poor" N = 33; in Category I "good" N = 49, "poor" N = 18.

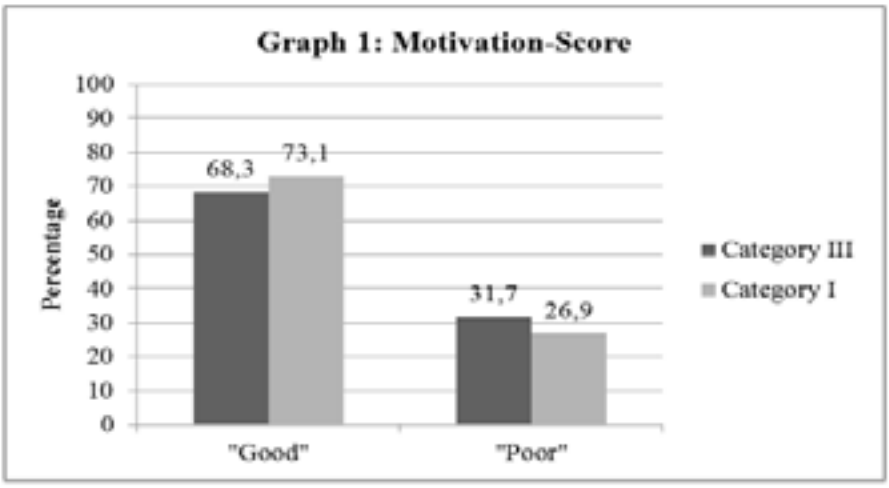


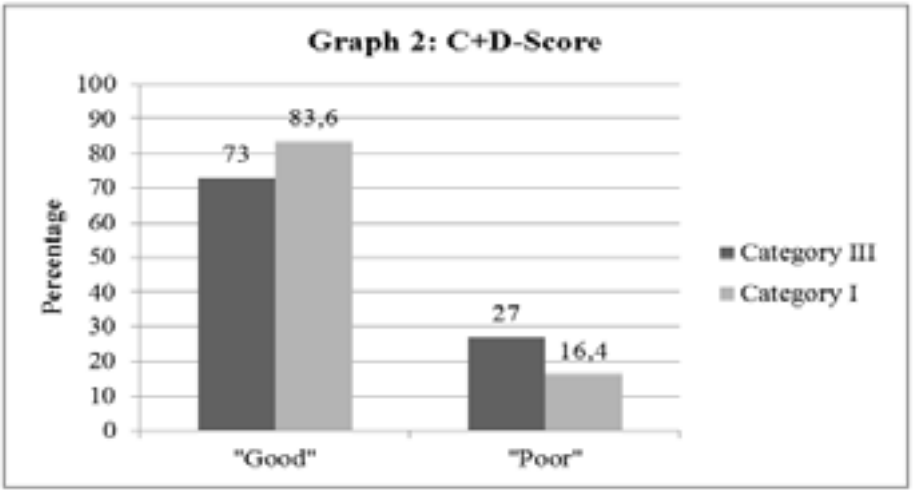
Table 2 shows the results of the "C+D-routine"-questions. Again, for each Category the amount (N) as well as the percentage (%) of "yes" and "no" answers are given.

Table 2 Results of the "C+D-routine"-questions

Question	Maximum Score	Answer Category III		Answer Category I	
		N	Yes / No %	N	Yes / No %
1. Animals	1	99 / 1	99.0 / 1.0	67 / 0	100.0 / 0.0
2. Damping	1	95 / 5	95.0 / 5.0	67 / 0	100.0 / 0.0
3. Warm Water	1	1 / 98	1.0 / 98.0	2 / 65	3.0 / 97.0
4. High Pressure	4	99 / 0	99.0 / 0.0	67 / 0	100.0 / 0.0
5. Soap	1	24 / 74	24.5/ 75.5	18 / 49	26.9 / 73.1
6. Rinse	1	15 / 83	15.3/ 84.7	15 / 52	22.4 / 77.6
7. Dry off	4	65 / 34	65.7/ 34.3	48 / 19	71.6 / 28.4
8. Heating	1	14 / 85	14.1 / 85.9	10 / 57	14.9 / 85.1
9. Solution	4	94 / 5	95.0 / 5.0	63 / 4	94.0 / 6.0
10. Concentration	4	92 / 7	92.9 / 7.1	64 / 3	95.5 / 4.5
11. Dosage 1	4	24 / 75	24.2 / 75.8	32 / 34	48.5 / 51.5
12. DVG-List	1	69 / 23	75.0 / 25.0	50 / 16	75.8 / 24.2
13. Reaction time	1	91 / 7	92.9 / 7.1	64 / 3	95.5 / 4.5
14. Dosage 2	4	87 / 9	90.6 / 9.4	63 / 3	95.4 / 4.6
15. Leftovers	1	29 / 70	29.3 / 70.7	16 / 51	23.9 / 76.1
16. Documentation	1	41 / 59	41.0 / 59.0	40 / 26	60.6 / 39.4

Note: Where the N does not add up to 104 for Category III or to 67 for Category I and the percentage does not add up to 100, information was missing.

Graph 2 shows the results of the "C+D-routine" score,given in percentage,the cut-off was at "25". In Category III "good" N = 73, "poor" N = 27; in Category I "good" N = 56, "poor" N = 11.



Neither the difference between the categories in motivation (OR 0.79, CI 95% 0.40 – 1.56)nor in the C+D-routine (OR 0.53, CI 95% 0.24 – 1.16)was found to be significant.

Discussion

As a general trend, the study did not reveal evidence, that motivation and case-control (i.e. Category) status are associated. However, this result is not free from different types of biases, namely selection, interview and (non-differential) misclassification.

First, it must be stated, that the farms in the control-group Category III are required by German law to implement measures against the Salmonella-problem of their herd. One may argue therefore that the controls are naturally highly motivated in order to change their Category-status, while the cases are highly motivated to maintain their present status. If this is true however, then there is a case of a non-differential misclassification and thus a dilution of the effect may be observed, i.e. the true value of the OR is decreased (Dohoo et al. 2003).

Secondly, participation in the study was voluntarily.This again may decrease the strength of effects.

It was however surprising to the authors that no significant difference between the C+D-routine of the categories could be determined, although a significant difference between residual Salmonella found in the environment had recently been observed (Gotter et al. 2011). Once again, the bias which is inherent in interviews concerning the social desirability of the answer must be pointed out (Meagher 2009). It is therefore possible that a different study approach, including perhaps the direct observation of the C+D-routine by the interviewer, may have led to different results.

Similarly, a more precise statement of some of the questions concerning the routine, for example how long a compartment was damped prior to cleaning, what kind of high pressure cleaner was used or what kind of disinfectant was utilized (acid or formaldehyde based) etc. might also have led to different results.

Conclusion

This study was not able to demonstrate a difference between cases and controls in regard to motivation and C+D-routine-procedures on the study farms. The hypothesis to explain this unexpected outcome is that the C+D procedures on the study farms are not "Salmonella-specific".There is still the need to raise the awareness in the farming community that the reduction of residual Salmonellacannot be achieved by only intensifying the C+D procedures, unless areas are included that so far have not been the target of "traditional" C+D-routines (biosecurity areas, hallways, loading ramps, transporters etc.).A different study approach, based not only on a questionnaire but also on direct observation, may be able to decrease the interview bias and therefore lead to different results. Further research in this direction is required.

References

Davies RH., Wray C., 1995, Observations on disinfection regimes used on Salmonella enteritidis infected poultry units, Poultry Science, 638-647.

Davies RH., Wray C., 1996, Studies of contamination of three broiler houses with Salmonella enteritidis before and after cleansing and disinfection, Avian Diseases, 626-633.

Dohoo I. et al., 2003, Veterinary Epidemiologic Research, Chapter 12.5 Bias from Misclassification, 220-222.

Gotter V. et al., 2011, A case-control study on the occurrence of Salmonella in the environment of pigs, Epidemiology and Infection, in press.

Meagher R., 2009, Observer ratings: Validity and value as a tool for animal welfare research, Applied Animal Behavior Science, 1-14.

Madec F. et al., 1999, Measurement of the residual contamination of post-weaning facilities for pigs and related risk factors, Journal of veterinary medicine series B,