Austrian model approach to assess quality of post-mortem feedback-information systems in pigs

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Abstract
A novel quality assurance approach was tested for its applicability to assess data validity and meat inspection performance by means of modeling and training of official meat inspectors (OMIs). General linear mixed models (GLMM) were used to estimate the variance in 20 selected lesions assessed by 12 official meat inspectors for 247,507 pigs. The pigs originated from 72 conventional farms and were slaughtered at one abattoir in Austria in the period January 2008 to June 2011. The heterogeneity in the health state of the pigs, variation due to the farms of origin, piglet producer, quarter and medication was considered in the statistical model. Based on the model meat inspection showed hardly any variation for post-mortem findings such as pericarditis, arthritis and milkspots, whereas meat inspection of blood aspiration, scalding water lungs, skin lesions and hepatitis can be deemed as not sufficiently standardized. Training of OMIs resulted in better detection rates of blood aspiration and pleurisy, but not in the detection of skin lesions related to slaughter technology and animal welfare. Grading of pneumonia has to be further improved in future training sessions. An improved data record system was established based on the outcome of the model and training of OMIs. In future research the benefit of the new code system and training effect to standardize meat inspection will be assessed in form of statistical re-evaluations.

Introduction
In order to revise meat inspection towards the introduction of a risked-based approach, information feedback systems have been established throughout Europe, legally required by European Commission regulations (EC) 854/2004 and (EC) 2074/2005 to grant safety along the production chain. It became mandatory for official meat inspectors (OMI) to record slaughter lesion data, and provide information about the predominant diseases affecting finishing pigs from the slaughter house to the pig producer and farm veterinarian, thus assist in monitoring disease in national herds. Although the variability in scoring lesions among OMIs is believed to be a major contributor to variability in lesion prevalence among slaughter prevalence in monitoring programs, hardly anyone has questioned the quality of data recorded in such databanks for reporting.

In Austria a novel quality assurance (QA) approach was evaluated for its applicability to assess data validity and meat inspection performance by means of modeling and training of OMIs. As described in Schleicher et al. (2013) statistical models were fitted to estimate the probabilities of a positive finding.

Furthermore, the amount of variation among these probabilities that contribute to the OMIs was determined by calculating variance partitioning coefficients (VPCs). Primary aim was to assess those lesions with the highest variability among OMIs for further training and to assess practically at the slaughter plant the feasibility of the model as training base.

Material and Methods
Study population
The population under study comprised all conventional pigs from 72 farms located in the province of Styria, Austria, that were slaughtered in the period January 2008 to June 2011. Farms included 21 (29.2%) fattening farms and 51 (70.8%) farms with “farrow to finish units”. Herd size ranged from 70 to 2025 finishing pigs. All farms participating in the study had no “all in/all out” management. Each farm sent batches of finishing pigs to slaughter according to growth performance. Additionally, only farms which sent more than 400 pigs to slaughter in the study period were included in the study. A total of 247,507 pigs were examined.

Meat inspection and Data recording
The study was conducted at one slaughter plant located in the province of Styria, Austria, slaughtering approximately 2000 – 2300 pigs per week. Finishing pigs were sent to slaughter with about 115 – 120 kg (253.5 – 264.6 lb). The abattoir killed about 115 -120 pigs per hour and used carbon dioxide stunning followed by conventional sticking with the animals lying on the side. At the slaughterhouse post-mortem data were recorded by a total of 12 official meat inspectors (OMI) with 11-
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19 years of experience in meat inspection. Each veterinarian was registered under a certain “vetcode” in the system of the slaughterhouse. Along the pluck- and carcass line the veterinarian was able to select post-mortem findings on a touch screen out of 55 pre-defined parameters. In the study focus was laid on 20 lesions according to their frequency and animal health significance from the abattoir company’s database. The parameters were assessed for their validity, thus quality in post-mortem feedback-information systems.

Statistical analysis
General linear mixed models (GLMM) were used to estimate the variability due to the OMIs for each of the 20 selected lesions as described in Schleicher et al. (2013). The heterogeneity in the health state of the pigs, the variation due to farms of origin, piglet producer, quarter and medication (PCV2 vaccination, deworming, scabies treatment) were considered in the statistical models. For each lesion the amount of dispersion among OMIs and the farm of origin were quantified in the model using Variance Partitioning Coefficients (VPCs). Special care was taken that a balanced sample was given for the models. Each of the 12 OMIs examined more than 6,000 plucks and more than 7,000 carcasses. The latter ensured that each OMI inspected plucks and carcasses of at least 51 out of 72 farms, and that pigs originating from one farm were examined by at least 7 OMIs. The models were implemented in R (version 2.14.2) using the package lme4.

Training of veterinarians in meat inspection
Eleven of the twelve OMIs participated in the practical training. Each of the OMIs had to examine 12 preselected carcasses and plucks within 12 minutes. They were asked to record lesions out of a list of 14 pre-defined pathological abnormalities, namely: mild, moderate and severe forms of pneumonia, pleuritis visceralis, blood aspiration, scalding water lungs, pericarditis, milkspots, perihepatitis, hepatitis, skin lesion related to a) slaughter technology b) infectious agent and c) animal welfare, scabies, pleuritis parietalis and arthritis. Precise definitions and guidelines were given beforehand. Additionally, the OMIs were asked to record multiple lesions, not only the most predominant one. Subsequently, a photo documentation of each lesion was completed.

Results
In the study period January 2008 to June 2011 247.507 pigs were examined by 12 OMIs. In total about 70% of the plucks and approximately 40-50% of the carcasses were recorded with lesions. A detailed list on slaughter statistics is given in Table 1.

The abattoir company’s database was screened and finally 20 lesions, namely 18 pathological abnormalities and 2 findings related to slaughter technology chosen for further evaluation according to their relative frequency (Table 2) and animal health significance.

Range of relative frequencies in lesions was found highest for blood aspiration, followed by scalding water, hepatitis, bursitis and skin lesion. The most frequent lesion was bursitis in carcasses (13.8%) and pneumonia (+/++/+++ in plucks (30.4%). However, a simple descriptive analysis will not allow a distinction between lesion variability due to farm/herd management and/or OMI performance. Therefore, a statistical analysis (GLMM) was conducted to estimate the influence of OMI and farm on each of the 20 lesions and to determine the level of standardization and homogeneity in meat inspection as an indicator for data quality. The results of the models include fixed effects (influence of quarterly time effect, farm type and piglet producer). Largest variance among OMIs (VPC estimates) was given for the finding skin lesion (3.9-20.8%), followed by blood aspiration (8.2-19.8%) and hepatitis (2.9-18.9%). A negligible amount of variation was determined concerning pericarditis (0 – 0.1%), peritonitis (0-0.6%) and arthritis (0-0.4%). Particularly large variation on farm level was shown concerning milkspots. Subsequent analysis of the raw data revealed that the pigs from 2 of the considered piglet producers showed a noticeably larger risk for severe milkspots (>3). Training of the OMIs improved the detection rate of blood aspiration (90.9-100%) and pleuritis visceralis (63.6-90.9%). However, hardly any improvement was given for the detection of skin lesions. Localization and severity of the skin lesions affected highly the detection rate of the OMIs (18.2-100%). In addition, a certain disagreement in recording multiple lesions was noted between OMIs. The

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**Table 1.** Number of pigs [%] slaughtered in the study period and number [%] of plucks, carcasses and number of pigs (carcass + pluck) recorded without lesion.

<table>
<thead>
<tr>
<th>criteria</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs total</td>
<td>56.760 [22.9]</td>
<td>68.013 [27.5]</td>
<td>74.890 [30.3]</td>
<td>47.842 [19.3]</td>
</tr>
<tr>
<td>Carcasses (C) no lesion</td>
<td>27.191 [47.9]</td>
<td>33.318 [49 ]</td>
<td>42.822 [57.2]</td>
<td>28.271 [59.1]</td>
</tr>
</tbody>
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\(^1\) originating from fattening farms  
\(^2\) originating from farms with farrow to finish units

*6months
performance among meat inspectors to assess different forms of pneumonia were found acceptable, but need to be further improved. Lowest variability was given for pneumonia +++, which was found consistent with the model.

**Discussion**

Meat inspection might be considered standardized and homogeneous if the probability of a specific post-mortem finding is independent of the OMI carrying out the examination. Emphasis was laid to establish a model fitted for real work conditions. In contrast to trial designs no repeated measurements or reference standards were available. Focus of the work was not the estimation of the rater’s sensitivity and specificity, but rather the analysis of the variation of the probabilities of a finding between different OMIs. It was considered essential in the model to take the variation between farms and seasonal effects into account to reduce the influence of the heterogeneity in the health state of pigs. Otherwise, the model fit might be poor, in particular for infrequent findings with low relative frequency (e.g. scabies). Findings for which there were different levels of gradation to choose from (i.e. pneumonia).typically exhibited larger variation among OMIs. In general good cooperation between trainer and OMIs was given. OMIs, who participated in the study, voluntarily gave feedback on how to improve the abattoirs’ data recording system.

**Conclusion**

Inspection of pigs at slaughter has been widely used in epidemiological studies of risk factors associated with raised prevalence of lesions. However, the prevalence of lesions recorded in databanks must be based on valid data and reflect a certain consistency in data recording of OMIs to establish a functional post-mortem feedback information system. The statistical model (GLMM) was found an essential and helpful tool to estimate on the one hand the amount of variation in post-mortem findings that can be accredited to the OMI and on the other hand as a training base for OMIs. As a consequence of the statistical analysis and training of OMIs an improved code record system will be established in the abattoir. Focus was laid to assess fewer findings, but with high animal health significance in the future. Precise guidelines and definitions on each lesion were provided for the OMIs in cooperation with the veterinary section of the local government. Frequent training sessions and a re-evaluation of the OMIs’ performance might be considered in the future to standardize meat inspection on the long term.

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**References**


SCHLEICHER, C., SCHERIAU, S., KOPACKA, I., WANDA, S., HOFRICHTER, J., KOEFER, J., 2013, Analysis of the variation in meat inspection of pigs using variance partitioning. Preventive Veterinary Medicine, [http://dx.doi.org/10.1016/j.prevetmed.2013.05.018](http://dx.doi.org/10.1016/j.prevetmed.2013.05.018)