Is pig abattoir inspection data useful for surveillance purposes?

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Abstract
Statutory recording of carcass lesions at the abattoir may have significant potential as a resource for health and welfare surveillance of livestock populations. Such data collected by the in Great Britain by the Food Standards Agency (FSA) are not currently used for surveillance purposes. There are concerns that data quality, combined with other issues, may make the outputs unreliable. In this study we postulate that FSA data could be used for surveillance purposes. To test this we compared FSA data with the British Pig Health Scheme (BPHS) (a targeted surveillance system of slaughtered pigs) and laboratory diagnostic scanning surveillance (FarmFile) data, from mid-2008 to mid-2012, for respiratory conditions and tail bite lesions in pigs at population level. Population temporal analysis showed an increase in respiratory disease in all datasets but with regional differences. For tail bite, the temporal trend and monthly patterns were completely different between the datasets. We conclude that there is potential to use these abattoir-derived inspection data as a component of a surveillance system to monitor temporal trends and regional differences of chosen indicators at population level. Overall a number of issues still need to be addressed in order to provide the pig industry with the confidence to base their decisions on these data. Similar conclusions, at national level, may apply to other livestock sectors. However, evaluation of the inspection and data collection processes, as well as similar validation exercises against other data sources will be required.

Keywords: *Abattoir data, surveillance, pigs*

Introduction
Surveillance plays an important role in the detection and control of endemic disease and/or welfare conditions providing estimates of their frequency of observations, prevalence or incidence. These estimates can be monitored over time and significant changes and new observations can be detected (1). This may lead to implementation of interventions with continued surveillance enabling the evaluation of their impact. In Great Britain, probably the most robust data sources (2) that are currently used, or have the potential to be used, for endemic disease surveillance in livestock species are the GB Veterinary Investigation Diagnosis Analysis (VIDA) database and statutorily collected abattoir inspection data. Furthermore the pig sector also has robust health schemes (3), which were purposively designed for specific surveillance purposes.

Statutorily abattoir-derived inspection data can be used for several purposes associated with public health, animal health and welfare and meat quality. The data for the conditions/lesions observed and recorded can be provided to the farmer and the farmer's private veterinary surgeon, to allow them to take action on-farm to improve animal health and welfare; i.e. it has the potential to be used at a producer level. However, the abattoir inspection data are not currently being used for surveillance purposes, e.g. to monitor trends of specific conditions or to detect significant changes in endemic disease trends. The pig health schemes in Great Britain were designed to provide information about specific endemic conditions of economic concern for producers, with relevant outputs provided both to individual producers and at a population (industry) level (4). The British Pig Health Scheme (BPHS) started in 2005 in England and Wales, and provides frequent feedback of benchmarked results from targeted abattoir inspections to the participating producers and their herd veterinarians (2). Since 1999, farm and laboratory data collected from voluntary laboratory submissions made across Great Britain, to APHA Veterinary Investigation Centres and Scottish Agricultural College's Consultancy Division's Disease Surveillance Centres, have been aggregated in the VIDA database (5), the Animal and Plant Health Agency (APHA) data is collated and stored in a database known as Farmfile. Carcass and non-carcass sample submissions are submitted through private veterinary surgeons for laboratory testing and diagnostic investigation. Results are sent back to the private veterinary surgeon and the data contribute to surveillance for the detection of new and emerging threats, including significant changes in endemic disease trends.

The aim of this study was to test if statutory abattoir inspection data has potential for surveillance purposes (i.e. to measure how much disease is present and how this changes over time), via a validation exercise, To achieve this abattoir-derived inspection data were compared with data from an existing health scheme and from voluntary diagnostic submissions for one health and one welfare condition over a specified time period.

Materials and methods
The data sources used for the population level analysis were FSA, BPHS and FarmFile. Datasets were collected to cover a 48 month period from June 2008 to May 2012. However, the FSA dataset only started at August 2009, following the implementation of a new electronic format for the data.

Two conditions were considered: respiratory conditions and tail bite lesions. FarmFile does not contain data for tail bite lesions. For respiratory conditions as each data source has different ways of assessing them, data were recategorised into a syndromic respiratory condition. The number of animals assessed and the number of individual animals that had any positive result for any of the lesions considered were summarised per batch.

For each of the datasets, the date of assessment was used to produce variables for the year and month of assessment. Statistically significant differences were considered when P<0.05. The data from each data source was modelled separately.

Respiratory lesions
A logistic model with robust cluster function for the unique farm identifier was used. The analyses were completed using Stata 12 (StataCorp. 2011).

Tail bite lesions
Generalised linear mixed models (GLMM) were used to estimate model parameters and investigate differences in temporal trends in each dataset. Farm of origin of the pigs was the random effect (national analysis). The analyses were completed using R version 2.12.1 from R Foundation for Statistical Computing. www.r_project.org.

Results

The FSA dataset had the largest number of unique holdings (31,578) and had the greatest number of pigs assessed (19,534,728) compared to the other data sources (2,543 and 2,699 holdings, 933,771 and 6,012 pigs assessed for BPHS and FarmFile respectively).

Respiratory conditions
In the multivariable temporal analyses, the BPHS model showed significant increasing odds of a pig having respiratory conditions in 2011 and 2012 compared to 2008 (Figure 1A) and that the months July and March had the lowest odds (Figure 1B). The FarmFile model showed that the odds of a respiratory case increased over the years with significant increases in years 2010 and 2011. In this model April had the highest odds and September had the lowest. Finally, the FSA model showed that the odds increased over the years and that 2010 and 2012 were significantly higher than 2009. The results for month showed that there were two peaks, with high odds in the spring months and in December.

Tail bite lesions
Results from the BPHS data indicate that odds of tail bite lesions declined over the years (Figure 2A). Odds were lower in 2011 and 2012 when compared with 2008. However, the highest odds were in 2010. The odds of tail biting were higher in July and lower in December compared to January (Figure 2B). Temporal patterns differed for FSA: the odds over the years increased with a similar peak in 2010, however the continued decline in 2012 - seen in the BPHS - was not observed. The patterns across the year by month were similar for the first half of the year (January to June) and then differed, with specific differences seen between the datasets in July and December. The odds were higher in May than January and lower in September and August compared to January. However, the 95% confidence intervals for the BPHS dataset are wide and overlap considerably.

Figure 1. Respiratory disease conditions in the three datasets (FSA, BPHS and FarmFile). Logistic regression odds ratio (OR) (dots) and 95% confidence interval (bars) from 2008 to 2012 (A) and from January (1) to December (12) (B).

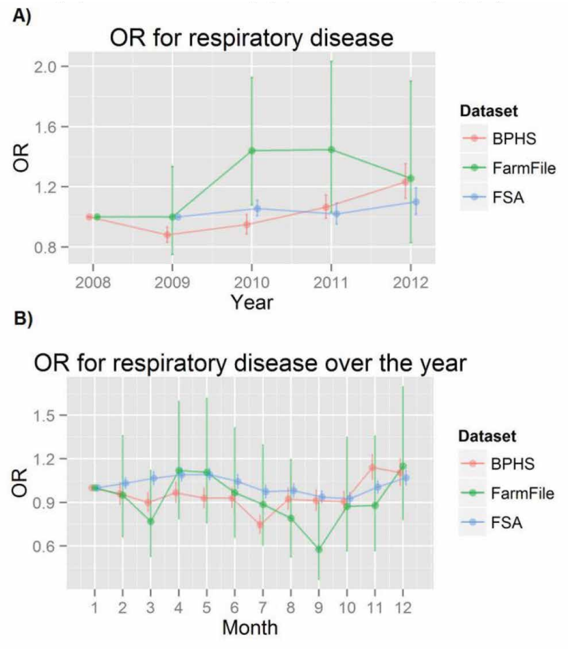
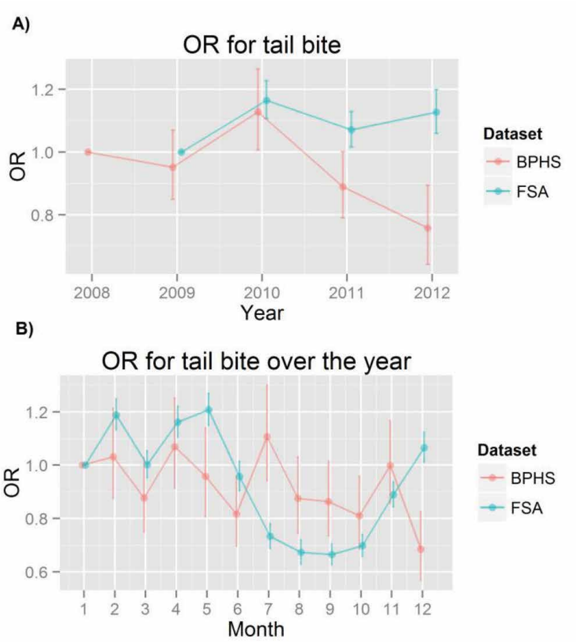


Figure 2. Tail bite lesions in the two datasets (BPHS, FSA). Prevalence estimate (dots) and 95% confidence interval (bars) from 2008 to 2012 GLMM odds ratio (OR) (dots) and 95% confidence interval (bars) from 2008 to 2012 (A) and from January (1) to December (12) (B).



Discussion

For respiratory conditions the yearly and monthly patterns were similar between the different data sources. For tail bite lesions the two data sources showed differences in both temporal patterns. The major difference was a year effect in 2012 and variations in the second half (June – December) of the year. In both sets of analyses the patterns in the FSA data are smoother. This would be expected from a larger, continuously collected dataset that encompasses the wider population. The FSA and FarmFile data complement each other for respiratory conditions. This too was expected; as subclinical conditions detected in the wider population may either be an indicative lead into an increase in clinical observations – and subsequent submission for diagnosis – or, as a sequela. When comparing BPHS and FarmFile data the same was not observed (one did not complement the other). BPHS is known to cover a smaller population of farms, with members representing only 75% of the commercial units (6). Furthermore, the intermittent (voluntary and quarterly) nature of the data collection will have an effect on the variability in prevalence estimates, particularly on a monthly basis. All of these aspects may contribute to the differences observed between the BPHS and FSA data for tail bite lesions. Additionally, the age of the assessed pigs in the datasets differs. BPHS pigs are slaughter age, finished pigs with an average age of 5.7 months (7), as are the vast majority of those contributing to the FSA dataset. FarmFile, however, can include data from pigs of any age, although those pigs being submitted for respiratory disease are usually younger than typical slaughter age pigs. This would have the consequence that, in the temporal analysis, an increase in prevalence of respiratory disease detected in weaners or growers, recorded by FarmFile, might not be expected to be reflected in lesions observed at slaughter until 6-16 weeks later i.e. the FSA and BPHS data would be expected to 'lag' FarmFile.

There are other data limitations that might influence the results. Firstly, BPHS and FSA record non-specific lesions, which has the advantage of high sensitivity but low specificity. In contrast, FarmFile records specific diagnoses with high specificity but low sensitivity due to submission bias. Secondly, the data, even within recategorised conditions, are not directly comparable due to the different definitions and criteria for recording (e.g. combination of multiple respiratory conditions in FarmFile data). This has resulted in a loss of sensitivity for patterns of specific respiratory conditions. Thirdly, there is also potential for misclassification; in the FarmFile data the main presenting condition would have been recorded, but in some cases other secondary conditions were not recorded. This is a known hazard in the FSA inspection system, too (8). In addition, for the FSA data, the conditions details were summarised into the total number of animals that had body parts rejected due to a condition. As data on individual animals was not provided, it was possible that some double counting of animals with conditions was included e.g. a batch with one record of tail bite and a record of fight/bite may have been the same animal and would have been recorded as two animals instead of one.

The results of our work suggest that the abattoir inspection data could, potentially, be used to measure the apparent prevalence of conditions and monitor trends over time within the slaughter pig population. This holds true, as long as the system remains stable in denominator population (number and type of pigs slaughtered; management types, ages, etc.), methodology and application.

While useful for temporal trends, further validation work would be required to investigate whether there is the potential to detect emerging or re-emerging diseases. The continuous nature of the data collection and the large numbers inspected make it easier to detect a statistically significant change in the overall population in a timely manner. The loss of sensitivity for some conditions and the larger scale may, however, mask more localised fluctuations that are of clinical significance within specified sub-populations or locations (which could be explored with scan statistics). Furthermore, it is expected that emerging and re-emerging endemic diseases will usually be detected before slaughter; for example by production and clinical monitoring at farm-level. Abattoir inspection could act as an ultimate 'fail-safe' in the case of failure at this level, particularly when faced with an insidious, sub-clinical, situation. It may enable an alarm to be raised when the other components fail (9,10).

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