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Comparison of whole carcass condemnation and partial carcass condemnation data for integration in a national syndromic surveillance system: The Swiss experience

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ABSTRACT

We obtained partial carcass condemnation (PCC) data for cattle (2009–2010) from a Swiss slaughterhouse. Data on whole carcass condemnations (WCC) carried out at the same slaughterhouse over those years were extracted from the national database for meat inspection. We found that given the differences observed in the WCC and PCC time series, it is likely that both indicators respond to different health events in the population and that one cannot be substituted by the other. Because PCC recordings are promising for syndromic surveillance, the meat inspection database should be capable to record both WCC and PCC data in the future. However, a standardised list of reasons for PCC needs to be defined and used nationwide in all slaughterhouses.

1. Introduction

The value of meat inspection (as defined by regulation (EC) No. 854/2004) as an animal health surveillance tool has been highlighted in several recent reports by the European Food Safety Authority (Dupuy, Hendrikx, Hardstaff, & Lindberg, 2012; Ellerbroek, Mateus, Stärk, Alonso, & Lindberg, 2011; Hardstaff, Nigsch, Dadios, Stärk, & Alonso, 2012), even though this value may depend on the disease or welfare condition targeted. Despite this recognition, systematic collection and use of meat inspection data for epidemiological surveillance are scarce at the European Union level (Harley, More, Boyle, O'Connell, & Hanlon, 2012), with a few notable exceptions such as the monitoring of *Salmonella* and *Trichinella* spp. This may stem from the fact that the purpose of meat inspection was historically focused on the detection of zoonotic infections before being recently broadened to encompass the surveillance of animal diseases that pose a lesser risk to public health (Budka et al., 2011). Nevertheless, a recent inventory of veterinary syndromic surveillance initiatives in Europe (Triple-S project) revealed 10 monitoring systems that use or plan to use meat inspection data from slaughterhouses (Dupuy et al., 2013). Denmark and the Netherlands were pioneers in this area with long-standing operational systems (over 30 years) (Elbers, Tielen, Snijders, Cromwijk, & Hunneman, 1992; Willeberg, Gerbola, Petersen, & Andersen, 1984), followed much later by other countries like Great Britain (Sanchez-Vazquez, 2011), while others like France have systems still in a pilot phase (Dupuy et al., 2013).

Relevant information from meat inspections must be made available to decision makers for the surveillance system to be of use for veterinary public health. Our study aims to evaluate Swiss slaughterhouse data for integration in a national syndromic surveillance system for early detection of emerging and re-emerging diseases in production animals. In this context, a syndrome is defined as "a set of non-specific pre-diagnosis medical and other information that may indicate […] a natural disease outbreak" (Fricker, 2008). Whole or partial carcass condemnations (WCC/PCC) following meat inspection could therefore be a valuable syndrome, and indirect indicator of regional herd health, as examined in Ontario, Canada (Alton, Pearl, Bateman, McNab, & Berke, 2010). It is unclear whether organ/body system PCC may be better suited for syndromic surveillance, as these data may provide more specific information on health outcomes than WCC data. By having a more specific outcome, it is hypothesised that PCC data should be more sensitive than WCC data because inspectors usually condemn an organ for one specific reason. However, carcasses may have several disease conditions causing the condemnation of the whole carcass.

In a previous study, we analysed the WCC data recorded by the Federal Food Safety and Veterinary Office for cattle, pigs and small ruminants slaughtered in Switzerland (Vial & Reist, 2014). Since 2007, the

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official veterinarians in charge of meat inspection and the cantonal veterinary services use the Fleischkontrolldatenbank (FLEKO federal database) to communicate the number of animals slaughtered and the meat inspection results to the Federal Office. Currently, the FLEKO only contains information about WCC. PCC do occur at a much higher frequency but their declaration to the Federal Office is not compulsory. The aim of this study was to obtain private data on PCC from a Swiss slaughterhouse and evaluate the extent to which PCC provide complementary data on herd health to WCC for integration in a national syndromic surveillance system for the early detection of emerging diseases in production animals. WCC and PCC time series were thus analysed in order to determine whether both indicators reflect similar health events in the cattle population or whether they provide complementary information for cattle health surveillance.

2. Materials and methods

2.1. Data extraction

PCC data for cattle were privately made available to the Veterinary Public Health Institute at Bern University by one Swiss slaughterhouse from canton Fribourg between the dates of 01/01/2009 and 31/12/2010. This slaughterhouse specialises in cattle and processed around 16% of all cattle carcasses slaughtered in Switzerland during those 2 years. For each PCC, information on the type of cattle, the reason for the PCC and the date were available. Data on WCC carried out at the same slaughterhouse over those 2 years were extracted from the FLEKO database (a description of which can be found in Vial & Reist, 2014): total number of carcasses processed (only available monthly), the daily number of WCC during normal slaughter and emergency slaughter (slaughter of sick or injured animals) and reasons for WCC.

2.2. Descriptive statistics

All statistical analyses and graphics were performed in R (R Core Team, & R Development Core Team, 2014). Both the PCC and WCC data were described in terms of carcass type distribution and reasons invoked for the condemnation.

2.3. Spatial distribution of condemnations

Full addresses of the cattle holdings that sent animals to the slaughterhouse were not disclosed; only information on the postcode and the town of the last known holding of each animal was available for PCCs. PCCs were aggregated by postcode. Each cattle WCC recorded in the FLEKO specifies the unique animal identification number of the animal as registered in the Swiss central animal movement database (AMD). The animal identification number allows the identification of the farm of origin, date of birth and all movement data corresponding to the animal. While the precise address of the last known holding before slaughter was known for WCC, we decided to aggregate WCC by postcode to remain consistent with the PCC data. Maps of the location of PCCs and WCCs were produced using the {sp} package (Bivand, Pebesma, & Gomez-Rubio, 2008).

2.4. Temporal effects

As the population offset (total number of animal slaughtered) was only available on a monthly basis, the following regression models were used on the daily carcass condemnation count data (and not rates). Regression models were used to model temporal effects such as day of week, month and year. No trend was assessed as the data only spanned 2 years. Swiss slaughterhouses only rarely operate on the weekend. As such, WCC made on Saturday were reclassified as Friday (3 instances corresponding to 7 carcasses and representing less than 1% of all WCC). In the first instance, a Poisson model was applied but evidence of overdispersion was encountered, and the standard errors from the Poisson model output were corrected using a quasi-GLM model, where the variance is given by φ (the dispersion parameter) $\times$ μ (mean). The residual deviance was used to perform a goodness of fit test for the overall model which indicated that the overdispersed Poisson model did not fit the data. Negative binomial models and zero-inflated negative binomial (ZINB) models were subsequently fitted to the data and compared using a likelihood ratio test. ZINB models were used to model two processes: a Poisson process (applied to the count data) and a binomial process (applied to the excess zeroes in the data). The test indicated that a ZINB approach was best suited to the WCC and nested ZINB models investigating the effect of day of the week, month and year were compared using likelihood ratio tests. The behaviour of the Pearson residuals of the final model was inspected to detect possible lack of fit or patterns in the residuals. Incidence rate ratios (IRR) were used to report findings. A similar approach was taken for PCC. PCC made on Saturday were reclassified as Friday (25 instances corresponding to 1825 PCC and representing 1.6% of all PCC).

3. Results

3.1. Description of condemnations

Between January 2009 and December 2010, 214,884 cattle were slaughtered. Over 97% of all slaughtered cattle were considered “normal

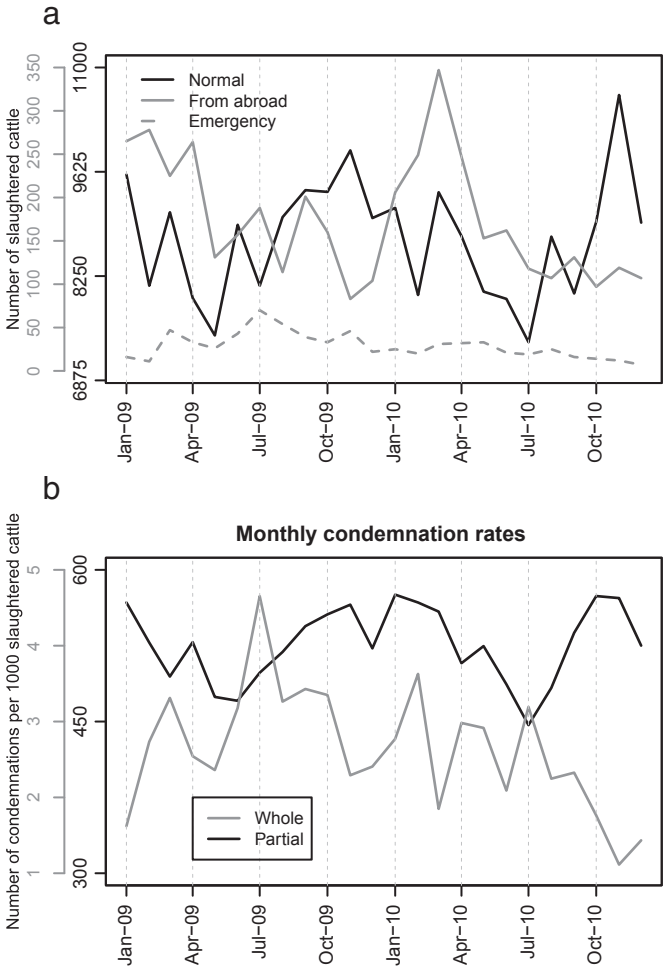

Fig. 1. Monthly time series of different slaughter types (a) and whole/partial carcass condemnation rates (b).