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Strengths and weaknesses of meat inspection as a contribution to animal health and welfare surveillance

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ABSTRACT

Meat inspection (MI) is one of the most widely implemented and longest running systems of surveillance. It was primarily introduced to identify meat of animals that is not fit for human consumption. Additionally, MI was progressively recognised as a suitable source of data collection and for monitoring a broad spectrum of diseases and conditions concerning animal health and welfare. For Europe, MI tasks are regulated at the European rather than country level and include a set of activities before and after stunning (*ante* and *post mortem* inspection) involving visual inspection, palpation and incisions. Over the last decade, the current MI protocol has been challenged because of its low sensitivity for important public health hazards. We aimed to assess the strengths and weaknesses of current MI protocols with primary focus on its utility in the context of animal health – including both notifiable and production diseases – and welfare, i.e. its capacity to detect cases with an aim to quantify the frequency of animal disease and welfare cases. The consequences of an alternative inspection protocol using visual-only inspection were also explored.

As a first step, a review of grey and published literature was conducted for a selected number of diseases and welfare conditions in seven species or species groups: swine, poultry, bovines, small ruminants, solipeds and farmed game, represented by red deer, wild boar, rabbits and ostriches. This review highlighted a substantial lack of suitable and accessible published data on the frequency of occurrence of many diseases and conditions affecting food animals in Europe. Additionally, there were very limited data on the detection performance of MI, particularly in relation to specific degrees of severity of clinical signs. Due to the data gaps, a large proportion of input data used in this work was based on expert opinion and general biologic manifestations of the conditions investigated. The probability of case detection was quantified using a scenario tree modelling approach, taking into account the frequency of case presentation and inspection coverage.

In general, the performance of MI was highly correlated with the presence of clinical and/or pathological signs in affected animals. Early or subclinical cases were likely to be "non-detectable" at slaughter. Regarding detectable cases, the impact of moving to visual-only inspection was negligible for most notifiable diseases and conditions considered with a few exceptions, primarily detectable cases of tuberculosis. Current MI activities were found to be effective to detect the majority of animal welfare conditions considered by species, predominantly by *ante mortem* inspection.

The effectiveness of MI was also considered for endemic diseases that are not currently subject to systematic control efforts. These included respiratory diseases and parasite infections. It was shown that

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MI could provide an efficient means of identifying producers in need of animal health advice, provided that information is collected and fed back to veterinarians and livestock farmers. Within an integrated information system, MI could substantially contribute to the control of a considerable range of animal health and welfare issues. Data already collected need to be made available for on-farm decision making. It was also noted that if the slaughter population is strongly affected by international trade, i.e. where a large proportion of animals originate from one country and are slaughtered in another, the usefulness of MI for endemic disease surveillance will be affected by either reduced coverage or bias or both.

In conclusion, our results indicate that while *ante mortem* inspection remains essential for the detection of animal welfare conditions, a move to visual-only *post mortem* inspection has – for the diseases and conditions considered – negligible negative impact on disease control. However in countries or regions that are not free of TB, special relevance of palpation and cutting of lymph nodes will have to be considered. MI information has considerable potential to inform disease control efforts, but only few countries use it systematically limiting the actual benefit that is achieved by these data. Finally, MI can also provide "back-up" surveillance in a situation where other means of detection fail and may represent the sole means of case detection for certain infections (e.g. liver fluke or cestodes).

1. Introduction

Meat inspection (MI) is one of the most widely implemented and longest running systems of surveillance. Its primary objective is to identify animals that are not fit for human consumption and to remove their carcasses and offal from the food chain. Additional objectives are to support animal disease control and to identify and prosecute animal welfare issues. As such, MI will contribute information on notifiable diseases and zoonoses, endemic production diseases and animal welfare. MI tasks are regulated at European Union (EU) level and include a set of activities before and after stunning/death, *ante* and *post mortem* inspection (AMI, PMI) involving visual inspection, palpation and incision of particular organs and lymph nodes (Regulation EC No. 854/2004).

Over the last decade, the current MI protocol has been challenged because of its low sensitivity for important public health hazards such as *Salmonella* and *Campylobacter*, and because of possible contamination risks (Berends, Snijders, & Van Logtestijn, 1993) as well as its associated costs. Considerable work was also conducted in Member States, most notably Denmark (Alban et al., 2008, 55 pp.; Pacheco, Brinch Kruse, Petersen, & Alban, 2013, 64 pp.). A revision of MI protocols is therefore being considered in Europe. In this context, the European Food Safety Authority (EFSA) was mandated to consider the consequences for animal health and welfare surveillance if a risk-based MI approach, focussing on the main public health hazards, was to be implemented. EFSA subsequently commissioned this study to assess how the detection performance for current and hypothesised future visual-only MI protocols would be affected by such changes, for a defined list of food animal species (i.e. pigs, poultry, bovines, sheep/goats, solipeds and farmed game). The current manuscript provides a summary of the work conducted by the authors under EFSA's mandate. Results of this work were then used by the relevant EFSA panels as input to the related opinions which are all published on the EFSA web site.

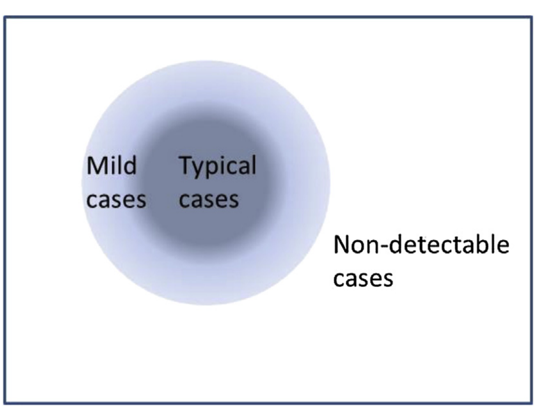

Fig. 1. Among all infected and affected animals sent to slaughter, there will be a significant proportion that are not detectable as cases because the inspection, palpation and incision tasks performed as part of *ante* and *post-mortem* meat inspection will be unlikely to identify them as cases. However, the natural course of disease will lead to the manifestation of signs that may lead to case detection. This will be easier for typical cases, but those should also be rarer as animals sent to slaughter are expected to be clinically healthy.

The sensitivity of MI procedures depends on both disease- and abattoir-related factors. For example, Bonde, Toft, Thomsen, and Sorensen (2010) found that the sensitivity of inspection for parasitic disorders was low, but much higher for respiratory diseases. Schemann, Hernandez-Jover, Hall, Holyoake, and Toribio (2010) documented the variability of inspection processes between abattoirs. Several studies (including Hathaway, Pullen, & McKenzie, 1988; Hathaway & McKenzie, 1989; Hill, Brouwer, et al., 2013; Hill, Horrigan, et al., 2013, 94 pp.; Moo, O'Boyle, Mathers, & Frost, 1980) investigated the effect of changing the inspection protocol on the detection performance for a range of different diseases. Attempts were made to quantify the probability of detection and the detection fraction (DF, the proportion of affected animals in the population that are successfully detected) as a measure of the effectiveness of the inspection protocols for case detection (Enoe, Christensen, Andersen, & Willeberg, 2003). To increase the accuracy of calculating the DF, it was recommended that the prevalence of the disease or welfare condition and related risk factors such as age should be taken into account (Hathaway et al. 1993; Berends, Van Knapen, & Snijders, 1996).

The aim of this article is to present selected results and general patterns to summarise and synthesise the findings of the assessment of MI as a means for case detection. Also, we draw general conclusions relevant for the future development of MI protocols and for the use of MI as a source of information for notifiable diseases and zoonoses, production diseases and welfare surveillance. The full reports for each species as well as the related opinions issued by EFSA's scientific panels can be found elsewhere (www.efsa.europa.eu; Dadios, Hardstaff, Alonso, Stärk, & Lindberg, 2012; Dupuy, Hendrikx, Hardstaff, & Lindberg, 2012; EFSA, 2012; Ellerbroek, Mateus, Stärk, Alonso, & Lindberg, 2012; Huneau et al., 2011; Hardstaff et al., 2012; Laugier & Lindberg, 2012).

2. Material and methods

2.1. General terminology and selection of diseases and conditions

According to current EU legislation, food animals can only be sent to slaughter if they are healthy and expected to yield a carcass