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Exploring expert opinion on the practicality and effectiveness of biosecurity measures on dairy farms in the United Kingdom using choice modeling

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ABSTRACT

Biosecurity, defined as a series of measures aiming to stop disease-causing agents entering or leaving an area where farm animals are present, is very important for the continuing economic viability of the United Kingdom dairy sector, and for animal welfare. This study gathered expert opinion from farmers, veterinarians, consultants, academics, and government and industry representatives on the practicality and effectiveness of different biosecurity measures on dairy farms. The study used best-worst scaling, a technique that allows for greater discrimination between choices and avoids the variability in interpretation associated with other methods, such as Likert scales and ranking methods. Keeping a closed herd was rated as the most effective measure overall, and maintaining regular contact with the veterinarian was the most practical measure. Measures relating to knowledge, planning, and veterinary involvement; buying-in practices; and quarantine and treatment scored highly for effectiveness overall. Measures relating to visitors, equipment, pest control, and hygiene scored much lower for effectiveness. Overall, measures relating to direct animal-to-animal contact scored much higher for effectiveness than measures relating to indirect disease transmission. Some of the most effective measures were also rated as the least practical, such as keeping a closed herd and avoiding nose-to-nose contact between contiguous animals, suggesting that real barriers exist for farmers when implementing biosecurity measures on dairy farms. We observed heterogeneity in expert opinion on biosecurity measures; for example, veterinarians rated the effectiveness of consulting the veterinarian on biosecurity significantly more highly than dairy farmers, suggesting a greater need for veterinarians to promote their services on-farm. Still, both groups rated it as a practical measure, suggesting that the farmer-veterinarian relationship holds some advantages for the promotion of biosecurity.

Key words: biosecurity, disease control, effectiveness, practicality, best-worst scaling

INTRODUCTION

Biosecurity, defined as a series of measures aiming to stop disease-causing agents entering or leaving an area where farm animals are present (Defra, 2003), is very important for the continuing economic viability of the United Kingdom dairy sector, and for animal welfare (Defra et al., 2004). The 2004 Animal Health and Welfare Strategy for Great Britain emphasized the responsibility of animal owners in managing animal health risks and states that costs should be increasingly borne by the industry rather than by taxpayers, putting more of an onus on farmers to tackle problems (Defra et al., 2004). The strategy also stated that veterinarians are uniquely placed to promote animal health and welfare and should be at the forefront of delivering proactive disease-prevention services. In a European context, a 2013 proposal for regulation on animal health, which will be implemented after 2016, similarly states that animal owners and professionals are in the best position to manage animal health, and that veterinarians should play an active role in disease prevention and raising awareness of disease risks (European Commission, 2013).

However, consensus is lacking over which biosecurity measures are most effective for stopping the spread of disease (Valeeva et al., 2011). Several reviews have synthesized information from field trials and other types of evidence about the effectiveness of biosecurity measures or the risk of disease introduction via different pathways, which can be seen as the corollary of evaluating the effectiveness of a biosecurity measure (Wells, 2000; Cooke and Brownlow, 2011; Maunsell and Donovan, 2008; Mee et al., 2012). Several studies have focused on particular diseases or conditions (Horst et al., 1996; Sørensen et al., 2002; Valeeva et al., 2005; Garabed et al.,

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2009; Gorden and Plummer, 2010; Gates et al., 2013; Kuster, 2013). However, evidence is lacking for the effectiveness of many of the biosecurity measures that are recommended on dairy farms, and some maintain that quantifying the effectiveness of a biosecurity measure based on experiments in controlled conditions is not an ideal approach to biosecurity because of the difficulty in extrapolating findings to working farms (Kuster, et al., 2015). Studies of farmers' attitudes to biosecurity have reported that the effectiveness of different measures is very important to them; farmers do not want to carry out practices that do not bring substantial benefits (Garforth et al., 2013). The practicality of measures has also been shown to be important to farmers; if the measure is effective but impractical to implement, then they are unlikely to carry it out (Kristensen and Jakobsen, 2011; Valeeva et al., 2011). However, no studies have explicitly looked into the practicality of biosecurity measures on dairy farms.

The dairy sector in the United Kingdom is the third largest milk producer in the European Union and the tenth largest in the world (Bate, 2016). Trends in the dairy sector in the United Kingdom have been in line with those of other industrialized countries, with a decreasing number of farms and increasing herd size and milk yield (AHDB Dairy, 2016). The average herd size in the United Kingdom in 2015 was 142 cows, and the average milk yield was 7,944 L/cow per year (AHDB Dairy, 2016). The majority of dairy farms in the United Kingdom operate a mixed grazing and housing system, with cows grazing in the summer and housed in the winter (Andersons Centre, 2013). A smaller number operate a low-input year-round grazing system, or a high-input year-round housing system. Since the 2001 foot and mouth disease outbreak, the government has been ceding control over certain areas of biosecurity to industry, as outlined in the 2004 animal health and welfare strategy (Defra, 2004). An exception is Scotland, where the government is supporting an industry-led scheme to eradicate bovine viral diarrhea (Voas, 2012).

Expert judgment is often sought in situations where problems are complex, where data are lacking, and where action is needed (Slottje et al., 2008; Martin et al., 2012). Bijker et al. (2009) state that in situations of "complex risks," the most appropriate course of action can be to try to clarify the factual base for making decisions about risk management and improve the reliability and validity of scientific knowledge by consulting with experts. A small number of expert studies have also been carried out looking into the most important or most effective biosecurity measures. Van Winden et al. (2005) undertook a systematic review of risk factors for 4 common cattle diseases and held an expert opinion workshop, asking experts to attribute a percentage risk to each risk factor and a risk reduction factor to different biosecurity measures. Sayers et al. (2014) asked expert veterinarians and veterinary practitioners to rate the importance of several biosecurity measures on dairy farms using a Likert scale.

Several limitations have been associated with these studies. First, they focused only on asking experts to rank the effectiveness or importance of a measure without considering their relative practicality. Second, they used Likert or rating scales to gather expert opinion which have methodological deficiencies. For example, Likert scales and rating scales can involve a "scale equivalence," which means that people may interpret a rating scale differently, varying significantly across cultures (Adamsen et al., 2013). Acquiescence bias may also be present, in that people tend to respond positively to questions more often than they respond negatively (Whitty et al., 2014). Rating and Likert scales also may not discriminate sufficiently between items (Louviere et al., 2013). Methods that ask people to rank items can become too cognitively demanding and unfeasible if there are more than 7 items (Louviere et al., 2013).

A technique that overcomes these methodological deficiencies is best-worst scaling (Finn and Louviere, 1992). Best-worst scaling is a choice method that presents people with a set of options (usually 4 or 5) and asks them to pick the best and the worst (Louviere et al., 2013). This method is often used to obtain information about preferences across a large number of items, because it is not as cognitively demanding as ranking many items (Adamsen et al., 2013). It also avoids scale bias, where respondents use only part of a scale or interpret the scale in different ways (Cohen and Orme, 2004). Best-worst scaling has been used in a range of different disciplines and contexts to elicit consumer preferences in market research (Adamsen et al., 2013) and health (Lancsar and Savage, 2004), and in an agricultural context it has been used to gather expert opinion on different greenhouse gas mitigation measures on sheep farms (Jones et al., 2013) and to assess the effectiveness and practicality of measures to control *Escherichia coli* O157 on cattle farms (Cross et al., 2012).

The aim of this study was to use best-worst scaling to gather expert opinion from veterinarians (hereafter, vets), farmers, academics, consultants, and industry and government representatives on the relative practicality and effectiveness of different biosecurity measures on dairy farms in the United Kingdom. The objective was to bring greater clarity to debates in the dairy sector about what biosecurity measures farmers can and should carry out in conjunction with their vet and to contribute to debates about initiatives that could improve biosecurity in the dairy industry.