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Distribution of cow-calf producers' beliefs regarding gathering and holding their cattle and observing animal movement restrictions during an outbreak of foot-and-mouth disease

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ABSTRACT

The voluntary cooperation of producers with disease control measures such as movement restrictions and gathering cattle for testing, vaccination, or depopulation is critical to the success of many disease control programs. A cross-sectional survey was conducted in Texas in order to determine the distribution of key beliefs about obeying movement restrictions and gathering and holding cattle for disease control purposes. Two questionnaires were developed and distributed to separate representative samples of Texas cow-calf producers, respectively. The context for each behavior was provided through the use of scenarios in the questionnaire. Belief strength was measured using a 7-point Likert-like scale. Producers surveyed were unsure about the possible negative consequences of gathering and holding their cattle when requested by authorities, suggesting a key need for communication in this area during an outbreak. Respondents identified a lack of manpower and/or financial resources to gather and hold cattle as barriers to their cooperation with orders to gather and hold cattle. Producers also expressed uncertainty about the efficacy of movement restrictions to prevent the spread of foot-and-mouth disease and concern about possible feed shortages or animal suffering. However, there are emotional benefits to complying with movement restrictions and strong social expectations of cooperation with any movement bans put in place.

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1. Introduction

Foot-and-mouth disease (FMD), as a highly contagious disease of cloven-hoofed animals, can spread rapidly through a naïve population, with commensurate losses in production and international trade. Studies of several past

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outbreaks of FMD have revealed that the size and severity of an outbreak are associated with many factors, such as: the time to detection of the introduction of the virus (Gibbens et al., 2001; Tomassen et al., 2002; McLaws and Ribble, 2007; Carpenter et al., 2011), the density of surrounding livestock and herds, the extent of early disease spread, the effectiveness of disease control measures (Ferguson et al., 2001; Tomassen et al., 2002; Wilesmith et al., 2003; Cottam et al., 2008; Bessell et al., 2010), the patterns of animal movements (Nielen et al., 1996; Bates et al., 2001), the initial species infected (cattle vs. sheep vs. pigs), and the characteristics of the virus itself (Barnett and Cox, 1999; Kitching, 2002; Alexandersen et al., 2003; McLaws et al., 2009).

Many of these epidemiologic factors are beyond the influence of veterinary authorities or livestock producers. However, some of these factors can be directly impacted by the behavior of livestock producers, such as disease reporting and preventing the movement of animals. These behaviors represent important targets for risk communication, since enhanced cooperation may reduce the size and severity of an outbreak. Some efforts have been made to understand producers' beliefs about disease reporting or on-farm disease control (Hopp et al., 2007; Heffernan et al., 2008; Palmer et al., 2009; Elbers et al., 2010; Delgado et al., 2012; Alarcon et al., 2014; Garforth et al., 2013) and the consequences of reporting on the severity of an outbreak (McLaws et al., 2007; Carpenter et al., 2011). However, other important producer behaviors which could impact the severity of a disease outbreak have received minimal attention.

During an outbreak of FMD, the primary control strategies used are movement restrictions and the rapid slaughter of infected and exposed livestock (Gibbens et al., 2001; McLaws and Ribble, 2007). In some countries, the application of vaccination, with or without the subsequent destruction of vaccinates, has also been applied or explored (Bates et al., 2003; Perez et al., 2004; Kitching et al., 2007; Barasa et al., 2008; Estrada et al., 2008). The success of these strategies rests, in part, on the willingness of producers to gather and present their livestock for testing, vaccination, or slaughter and to obey movement restrictions.

Although gathering and holding cattle may not be problematic in some areas or production systems, cow-calf production in Texas uses predominantly extensive rearing practices. Based on forage quality or availability, cattle may be stocked at very low stocking densities, allowing the cattle to spread out over huge sections of land. Gathering cattle on these large properties can require the use of cowboys, dogs, and/or helicopters, at substantial expense to producers (Delgado et al., 2012). Other areas in Texas are covered by thick brush which can make finding and moving cattle very difficult. As a result, producer cooperation in gathering and holding cattle kept under these conditions is essential. During the 2001 outbreak of FMD in the UK, a large number of livestock owners (over 200 in Devon alone) turned to the legal system in order to prevent the deaths of their animals due to the contiguous culling policy that was in force (Woods, 2004). Some producers barricaded their farm entrances and refused access to their land, which ultimately required police intervention to resolve (Guardian, 2001). In Texas, cattle producers' refusal to gather their cattle for testing continues to be one of the major challenges to the control of the *Boophilus* tick, and some producers may refuse authorities access to their cattle until a judge requires them to comply, which may take up to 9 months to resolve (Delgado et al., 2012).

FMD has traditionally been very difficult to control and eradicate due to the numerous ways which the disease can spread (Thomson and Bastos, 2004). However, the most common mode of transmission involves the movement of infected animals followed by direct transmission to susceptible animals (Donaldson et al., 2001). Animal movements have been implicated as contributing to the extremely large magnitude of the epidemics in both the UK and Taiwan (Yang et al., 1999; Ferguson et al., 2001; Gibbens et al., 2001). The outbreak in the UK in particular was characterized by the widespread movement of animals through livestock markets prior to disease detection (Anderson, 2002), and some researchers have hypothesized that the movement of animals through markets is the factor most likely to be associated with an extremely large outbreak (McLaws et al., 2009).

Movement restrictions are used during an outbreak to reduce the spread of disease, and more recently they have been used prior to an outbreak in order to change the structure of normal animal movement with the hope of limiting the size of future outbreaks (Velthuis and Mourits, 2007). However, cattle producers in the United States rely heavily on the ability to move livestock in response to changing feed, weather, and market conditions. Results from a survey examining beef cattle movements in California found that respondents kept cattle at up to five different locations throughout the year (Marshall et al., 2009). Beef cattle were moved between states more than two times annually, and more than 40% of the reported movements were to sale yards or auction barns. A separate study, focused on exhibitors of livestock at the California State Fair, found that the state livestock fair brought together animals from almost every county within the state, with 97% of the animals participating in the fair expected to return home afterwards (Thunes and Carpenter, 2007). The survey also found that the animals had participated in a median of three events during the past year, and in general the reported biosecurity practices of the respondents were minimal.

During an outbreak of FMD, movement restrictions can result in economic losses for producers as cattle gain past their ideal market weight or deteriorate due to lack of feed or space. Several recent, large-scale outbreaks have highlighted the secondary effects that movement restrictions can have on animal well-being and the economic costs associated with the killing of animals for welfare reasons (Yang et al., 1999; Anderson, 2002; Whiting, 2003). During the 2001 outbreak of FMD in the UK, at least 2.5 million animals were slaughtered in response to welfare concerns (Haydon et al., 2004). Feed and bedding were identified as the scarcest resources (Laurence, 2002), while over 250,000 licenses for movement were issued between March and September 2001 to alleviate crowding