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Qualitative and quantitative impacts assessment of contagious bovine pleuropneumonia in Fulani pastoral herds of North-central Nigeria: The associated socio-cultural factors

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ABSTRACT

Contagious bovine pleuropneumonia is one of the most important trans-boundary disease affecting Fulani cattle herds of Nigeria and whose control is urgently needed. A Participatory Epidemiology approach and cross-sectional study were concurrently conducted to investigate qualitative and quantitative impacts of CBPP, respectively and associated socio-cultural factors that influenced exposure of Fulani nomadic pastoral communities to its risk in Niger State, North-central Nigeria between January and December 2013. A total of nine pastoral communities were purposively selected for qualitative impact assessment using Participatory Rural Appraisal tools, while 765 cattle randomly sampled from 125 purposively selected nomadic herds were analyzed using c-ELISA. Data on socio-cultural characteristics were collected using structured questionnaires administered on nomadic herd owners of the 125 selected herds. Kendall's Coefficient of Concordance W statistics and OpenEpi 2.3 were used for statistical analyses. Pastoralists' dependent factors associated with their socio-cultural activities were tested using Chisquare tests and likelihood backward logistic regressions. The mean proportional piles (relative qualitative impact) of CBPP was 12.6%, and nomads agreement on this impact was strong (W = 0.6855) and statistically significant (P < 0.001). This was validated by 16.2% (95% CI: 13.7, 19.0) sero-positive (quantitative impact). Highest sero-prevalence of 25.3% was observed in Northern agro-ecological zone, while lowest of 6.2% was in Eastern zone. Pastoralists in the age groups 51–60 and 61–70 years were more likely (OR 13.07; 95% CI: 3.21, 53.12 and OR 7.10; 95% CI: 1.77, 28.33, respectively) to have satisfactory information/awareness on CBPP and lowland transhumance pastoralists were more likely (OR 5.21; 95% CI: 2.01, 13.54) to have satisfactory information. Socio-cultural activities of extensive husbandry system was six times more likely (OR 5.79; 95% CI: 2.55, 13.13) to be satisfactory practice that influenced CBPP occurrence in herds, while culture of borrowing and loaning of cattle was twenty times more likely (OR 19.94; 95% CI: 6.36, 62.48) to be satisfactory practice that influenced CBPP occurrence in herds. Also, sharing a water source that caused concentration of stocks in one point was fifty three times more likely (OR 53.08; 95% CI: 14.91, 189.00) to be satisfactory practice that influenced occurrence of the disease in herds. This study highlighted the critical gap that exists in terms of significant influence of socio-cultural factors on CBPP occurrence in pastoral herds in Nigeria. Thus, CBPP surveillance, control and prevention programs that take these factors into consideration will be beneficial to the livestock industry in Nigeria, and indeed Africa.

1. Introduction

Contagious bovine pleuropneumonia (CBPP) is an infectious and contagious respiratory disease of cattle caused by *Mycoplasma mycoides* subsp. *mycoides* (*Mmm*) (Tardy et al., 2011), previously further specified as Small Colony (SC) type (Manso-Silván et al., 2009). It is characterized by sero-fibrinous interlobular edema and heparization of lung in acute to sub-acute cases and capsulated lesions (sequestra) in chronically infected cattle (Vilei and Frey, 2010).

CBPP is an OIE listed disease and second most important trans-boundary disease of cattle after rinderpest (Tambi et al., 2006). It

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is insidious in nature with the majority of cases remaining subclinical (Amanfu, 2009; Kassaye and Molla, 2012). Once CBPP is introduced into a naïve cattle herd, it causes high morbidity and mortality and those animals that survive remain chronic carriers (Schubert et al., 2011). The disease represents a major constraint to cattle production in sub-Saharan Africa and has ability to compromise food security through loss of protein and draft power by infected cattle (Amanfu, 2009; Morobela, 2011; Kassaye and Molla, 2012). With increasing globalization and continued presence of CBPP in cattle herds in African countries, it constitutes a serious threat to their food security and international trade (Obi, 2005).

CBPP is associated with massive economic losses for cattle keepers in many parts of the world (Windsor, 2000; Tambi et al., 2006; Jiuqing et al., 2011). It impacts animal health and poverty of livestock-dependent people through decreased animal productivity, reduced food supply for households, and the cost of control measures in Africa (Tambi et al., 2006). With rinderpest eradicated, CBPP is the most important trans-boundary animal disease of cattle, and a barrier to trade in many African countries as it reduces the value of livestock and the income of many value chain stakeholders (Jores et al., 2013). While the disease was eradicated from the United States by mid-20th Century, it was not eradicated from Europe until end of 20th Century, and still persists in many African countries, especially in the West, Central, East and parts of Southern Africa (Nicholas et al., 2008). The declined in CBPP outbreaks and burden reports in Nigeria and other affected African countries does not augur well for the implementation of internationally coordinated control programs due to absence of science based evidence for the disease impact assessment, which underpins control and preventive actions (Amanfu, 2009).

Nomadic pastoral communities in Africa live in some of the most underdeveloped environments in the world. Although these communities are reliant on their livestock as a source of social and economic well-being, conventional veterinary services are poor and basic information on the epidemiology of important livestock diseases is limited. Epidemiological research and disease surveillance in such pastoralist areas are difficult because human populations are relatively small and highly mobile, and they move their livestock across large areas with few roads and means of modern communications (de Leeuw et al., 1995; Catley, 2006). In such situations, conventional approaches to veterinary research and disease surveillance require considerable flexibility and commitment. Given the resource and logistical constraints in such pastoral areas, pastoralists themselves are a valuable source of disease information (Thrusfield, 2009).

The main biophysical determinants of CBPP occurrence in herds are the presence of infected animal with *Mmm*, susceptible cattle and the environment for interface. However, social determinants of health that include socio-cultural factors of income, education, occupation, sex, tribe, and cultural practices have the potentials to influence the outcomes of disease (Rutto et al., 2013; Alhaji and Kabir, 2015). Cattle managed under pastoral extensive system are persistently at risk of contracting contagious diseases, including CBPP, due to continuous mixing of herds at grazing and watering points, and as well as socio-cultural practices of giving out cattle as dowry and gifts (FAO, 2000; Mariner et al., 2006). These practices inhibit CBPP control strategies. Information on socio-cultural factors that could influence pastoral cattle herds and expose them to risk of CBPP is not readily available. Therefore, understanding these characteristics of pastoralists that include their demography, disease epidemiology, husbandry practices, physical environment that could predisposed to occurrence of CBPP is necessary. Availability of such science based information would assist in the development of surveillance and control strategies for the disease in Africa.

The objectives of this study were, to assess qualitative impacts of CBPP in Fulani nomadic herds, validate with quantitative sero-prevalence burdens, and investigate associated socio-cultural characteristics of Fulani nomadic pastoralists that could influence exposure of their cattle herds to risk of the disease in North-central Nigeria. Our null hypothesis was that socio-cultural practices of the Fulani nomadic pastoralists cannot have influence on their herds and therefore could not predispose the animals to CBPP. Also, a concentric convergence model of biological, physical (environmental), and socio-cultural interface was postulated for the disease occurrence and likely intervention points for its mitigation. The studied herds were under zero vaccination status because the last CBPP vaccination campaign in the state was carried out in November 2011. The T1/44 vaccine used in Nigeria has limited efficacy as it conferred relatively short period of six months immunity (Egwu et al., 1996). For vaccination to be effective, it must be repeated initially at short intervals of six months and thereafter annually over 3–5 years (FAO, 2002; FAO, 2004a,b). Based on these reports, protection of cattle populations in the state against *Mmm* infection by vaccination was considered to be zero status during the period of survey beginning from January 2013. Even the previous campaigns before the 2011 exercise were irregular due to logistic problems.

2. Materials and methods

2.1. Study area

The study was conducted in Niger State, located in the North-central geopolitical zone of Nigeria, between latitude 8° 20′N and 11° 30′N, and longitude 3° 30′E and 7° 20′E. According to the Nigerian Livestock Resources Survey, the state has an estimated cattle population of about 2.4 million cattle in 2012 (MLFD, 2013), mostly in the custodies of Fulani nomadic pastoralists. It has three Agro-ecological zones with variable climatic conditions; which are: Agro-ecological zone A or Southern zone with eight local governments areas (LGAs) and many rivers and fadamas; Agro-ecological zone B or Eastern zone with nine LGAs, many mountains, trees, and few rivers; and Agro-ecological zone C or Northern zone with eight LGAs, large grazing areas, many stock routes, and an international border with the Republic of Benin, which is porous (MLFD, 2013). The state also provides transit routes for nomadic pastoralists on seasonal migrations from the northern parts to the south-western and south-southern parts of Nigeria.

2.2. Social structure of populations surveyed and study design

The target populations were Fulani nomadic pastoral communities, who are seasonally mobile, with scattered herds of local breeds of cattle (Bunaji, Rahaji and Bokoloji), domiciled in remote areas of the state during the study period. Average number of herds that formed a nomadic pastoral community was 28, each managed by herd head or owner (a man, his wives and children, or an elderly widow and her children). Average number of animals in a herd was 82 cattle of variable ages.

Participatory Epidemiology (PE) approach was conducted using participatory rural appraisal (PRA) tools in nine Fulani nomadic pastoral communities of Lapai, Eyagi, Lemu, Paiko, Kuta, Bosso, Wushishi, Bobi grazing reserve and Borgu between January and December 2013. PE approach was applied in this survey to collect semi-quantitative data from piled and ranked cattle diseases relative to their impacts in the nomadic pastoral communities. A cross-sectional study was carried out on 765 cattle selected in 125 Fulani nomadic herds from the nine pastoral communities in the three Agro-ecological zones. A questionnaire-based interview was administered on the selected herds' owners at the community levels and relevant information collected. Inclusion criteria for the herders administered questionnaires were, that he/she must be