Preventive Veterinary Medicine 144 (2017) 123–133

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Epidemiological features and financial loss due to clinically diagnosed Haemorrhagic Septicemia in bovines in Karnataka, India

G. Govindaraj*, P. Krishnamoorthy, K.R. Nethrayini, R. Shalini, H. Rahman

ICAR- National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Ramagondanahalli, Yelahanka, Bangalore, 560 064, India

ARTICLE INFO

Article history:
Received 7 September 2016
Received in revised form 31 May 2017
Accepted 31 May 2017

Keywords:
Haemorrhagic Septicemia
Endemicity
Mortality
Morbidity
Case fatality
Financial loss

ABSTRACT

The epidemiological features and financial losses due to Haemorrhagic Septicemia (HS) in bovines were studied in Karnataka state using the primary data collected from 133 clinically diagnosed HS affected farms. The various losses due to HS and the Benefit- Cost of the vaccination programme in cattle and water buffaloes were studied using mathematical models. The number of HS outbreaks were higher during the year 2002 and peaked during 2005 and thereafter declined due to targeted vaccination against HS. The morbidity and mortality risks were lower in large farms than medium and small farms, and lower in indigenous cattle compared to high yielding crossbred cattle and water buffaloes. The disease occurrence was more in in-milk animals causing serious economic loss to the farmers. Most outbreaks were observed during monsoon season, though the disease was prevalent throughout the year. The mean milk loss per animal was $2, $11 and $50 in indigenous cattle, water buffaloes and crossbred cattle, respectively. In the case of draught animals, the average effective draught power was unavailable for 1.2 days/outbreak resulting in a loss of $5 per affected oxen. The treatment and extra labor expenses incurred per animal were $24 and $7, respectively. The average loss per animal due to mortality loss was $275, $284 and $415 in case of indigenous cattle, water buffaloes and crossbred cattle, respectively. The projected loss for the state of Karnataka were $23.89, $17.92 and $11.95 million under high, medium and low HS incidence scenarios, respectively. The Benefit Cost Analysis (BCA) of the vaccination against HS has been estimated at 5.97:1, 4.48:1 and 2.98:1 under high, medium and low incidence scenarios, respectively. The results highlight the important epidemiological features and financial losses to the affected households and the state of Karnataka.

1. Introduction

Haemorrhagic Septicemia (HS) is an important bacterial disease caused by *Pasteurella multocida* that primarily affects cattle and water buffaloes. It is an acute, septicemic fatal disease in bovines, especially in tropical countries of Asia and Africa (Bain et al., 1982; De Alwis, 1992). Haemorrhagic Septicemia is considered economically to be the most important disease in Southeast Asia including Indonesia, Phillipines, Thailand, Malaysia, Middle East, North East, Central and South Africa (Verma and Jaiswal, 1998). The organism remains in the upper respiratory tract as a commensal and causes the disease when the animal undergoes stress. Haemorrhagic Septicemia is clinically characterized by an initial phase of temperature elevation (often unnoticed), followed by a phase of respiratory involvement, and a terminal phase of septicemia and recumbence leading to death. The causative organisms have been grouped into five serogroups namely A, B, C, D, and E (De Alwis and Vipulassiri, 1981; Borkowska-Opacka and Kedrack, 2003; Kedrak and Borkowska- Opacka, 2003; Kumar et al., 2004) and the serotype B:2 is associated with bovine HS in Asia (Benkirane and De Alwis, 2002).

HS is endemic in India with most of the states reporting the disease (Venkataramanan et al., 2005). The disease is acute and often causes death primarily in water buffaloes and cattle, with occasional reports on other domesticated and wild mammals (De Alwis, 1992; Ahmed, 1996; De Alwis, 1999; Bain et al., 1982). In India, HS ranks second during 1991–2010 in terms of the number of outbreaks reported after Foot and Mouth Disease (FMD) outbreaks (Gajendragad and Uma, 2012). HS accounts for 58.8% of the aggregate bovine mortalities due to five major diseases and causes 50,000–55,000 deaths in animals causing significant financial losses to farmers (Dutta et al., 1990; Singh et al., 1996; Dua, 2003). In India, there are few studies on impact on livestock diseases (Thirunavukkarasu and Kathiravan, 2010; Govindaraj et al.,

* Corresponding author at: ICAR- National Institute of Veterinary Epidemiology and Disease Informatics (ICAR–NIVEDI), Ramagondanahalli, Yelahanka, Bangalore, 560 064, India.

E-mail addresses: Govindaraj.Naidu@icar.gov.in, mggraj74@gmail.com (G. Govindaraj).

http://dx.doi.org/10.1016/j.prevetmed.2017.05.027

2015; Govindaraj et al., 2016), but the loss due to HS in cattle and water buffaloes are limited. Few studies have used secondary information for various time periods and while some studies assumed few factors/components such as mortality and culling levels, and projected the losses for the entire country (Venkataramanan et al., 2005; Singh et al., 2014a).

Agriculture and animal husbandry are the mainstay of the people of Karnataka state, India. The total farm families (cultivators) engaged in agriculture and allied occupations stood at 6.58 million of which 4.29 million owned bovines (Department of Animal Husbandry and Veterinary services, 2015). The value of output of livestock sector of Karnataka state was USD 1,606.9 million (INR.96, 419 million) amounting to 16.5% of value of output of agriculture and allied sectors of the state (CSO, 2013). The growth of the animal husbandry sector in the state is limited due to sub-optimal nutrition supplementation, poor rearing conditions, and burden of various viral, bacterial and parasitic diseases. Among the bacterial diseases reported in bovine in Karnataka, HS stands first since 2000–01, but the epidemiological analysis on morbidity, mortality, seasonal occurrence, endemicity, farm management conditions etc. in HS affected farms is lacking. Further, the loss estimates due to mortality loss, milk loss, draught power loss, extra labor engaged for nursing the animal and treatment cost across the species (indigenous cattle, crossbred cattle and water buffaloes) and Benefit-Cost of mass vaccination against HS are also not available thereby leading to lack of evidence to adopt appropriate policy measures to control and mitigate the disease in the state. Hence, the present study was attempted to address these gaps in the epidemiological, financial and management aspects of HS in Karnataka state through a primary survey from HS affected farm-owners.

2. Materials and methods

2.1. Study area

Karnataka state, India was selected for the present study. It is the seventh largest state by area covering 191,976 square kilometers. As per 2012 census, the total livestock population in this state was 29.00 million, of which, cattle and water buffaloes were 9.51 million and 3.47 million, respectively. The total livestock population in Chitradurga district was 1.64 million, of which cattle and water buffaloes were 0.28 million and 0.15 million, respectively. In Hassan district, the livestock population was 1.05 million, of which cattle and water buffalo were 0.60 and 0.14 million, respectively (DAHD&F, Government of India, 2012). The location of the primary survey for the preset study is presented Fig. 1.

2.2. Sampling procedure and data

The annual data on HS disease outbreaks, diagnosed and death cases reported in different districts of Karnataka state during 2002–03 to 20013–14 were collected from the Animal Disease Surveillance Scheme, Department of Animal Husbandry and Veterinary Services (DAH&VS), Government of Karnataka. The geographical location of HS outbreak villages and sampling procedure adopted for primary survey is presented in Fig. 1 and Table 1, respectively. A total of 133 HS affected farms were surveyed in Chitradurga and Hassan districts of Karnataka state during 2011to 2013. The primary data on various socio-economic and livestock parameters were collected through pre-tested schedules from clinically diagnosed HS affected cattle and water buffalo farms. Besides identifying the farms based on triangulation, a case definition comprising the major clinical signs (sudden onset of high temperature, shortness of breath, nasal discharge/blood stained nasal discharge, hot and painful subcutaneous swelling, sub-mandibular edema, brisket edema, upper respiratory tract distress, restlessness, muscular tremors, lacrymation and death within 24 h) were also included in the schedule to ascertain the HS disease incidence in the surveyed farms. Besides the socio-economic details of the farmer, the epidemiological parameters like number of animals in the farm, species, their age and sex; number of animals affected by HS and their age and sex; number of dead animals of different species and age groups; month in which the outbreak occurred; farm management parameters like feeding pattern, spacing, shed type etc., were also collected from HS affected farms.

Further, the observed milk yield of various HS affected animals during the morbidity (actual) and the week previous to onset (expected), the number of days for recovery of the animal, duration of illness in draught animals, incremental manpower hours engaged in the farm for nursing the infected animals, number of died animals their age and sex etc., were collected through a primary survey. The expected milk yield was calculated as the average normal milk yield per day realized in the immediate past week before HS infection whereas, actual observed milk yield was the milk yield per day per animal during the HS infection. The farm-gate milk price of $0.40/litre and $0.43/litre for cows and water buffaloes, respectively was used for computation. The farm size was classified based on the number of bovines reared by the farmers: small (1–2 animals), medium (3–4 animals) and large (>5 animals) (Govindaraj et al., 2015). The data were collected by the personal interview method after obtaining an oral consent to participate in the survey. The price of cattle and water buffaloes milk per litre (INR) was collected from the dairy milk union where the farmers sell milk and the labour wage rate (INR) and draught power hiring charges (INR) were collected from farmers and pertains to the rates that prevailed in the surveyed villages. The value of the animals of different species, age and sex pertained to farmers estimate, whereas the treatment cost was based on the actual cost incurred by the farmers. The loss per animal were converted to 2013 constant price for easy comprehension. The estimated values in INR was converted to USD at the exchange rate that prevailed during March 2014 (1USD = INR.60.0) (Govindaraj et al., 2015).

2.3. Epidemiological analysis

The epidemiological parameters pertinent to HS like geographical distribution, seasonal occurrence, mortality, morbidity, case fatality etc., were studied. The HS endemic regions were classified into low (prevalence range from 0.01–0.30 per 10,000 animals at risk), medium (prevalence range from 0.31–0.6 per 10,000 animals at risk) and high (prevalence greater than 0.61 per 10,000 animals at risk) and mapped using Quantum GIS version 2.10, PISA. The class interval cutoffs were based on the mean ± 0.5 sd of overall average HS prevalence level during 2003–04 to 2013–14. The data collected through primary survey (livestock inventory, HS diagnosed and death cases) were used to estimate morbidity, mortality and Case Fatality Rate (CFR) in the HS affected farms.

2.4. Estimation of financial loss

The visible loss due to HS (mortality, milk loss, non-availability of draught power, cost of treatment and extra labor engagement cost incurred to nurse the HS infected animals) in different species were calculated using primary data and the formulae for calculating the different losses are presented below

2.4.1. Average milk yield reduction loss per animal

$$M = \left(\sum_{i=1}^{n} (E_i - A_i) * N * U\right) / n$$

where, M = Milk yield reduction loss due to HS per animal (USD); E_i = Expected milk yield in i^{th} animal/day (litres); A_i = Actual