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Review on Epidemiology and Economic Importance of Lumpy Skin Disease in Ethiopia

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Abstract: Lumpy skin disease is an important cause of mortality and reduced productivity. LSD is a transboundary emerging 'list A' disease caused by lumpy skin disease virus and considered as a disease of high economic pressure because of its ability to compromise food security through loss of draft power, decrease productivity, increase production costs and ban or restrictions of international trade of livestock. Lumpy skin disease was one of the newly emerging diseases of cattle first observed in the northwestern part of the Ethiopia (Southwest of Lake Tana) in 1983 and now spread to almost all regions and agro-ecological zones of the country. The disease is mainly transmitted by arthropod vectors and the incidence of LSD is high during wet seasons when biting-fly populations are abundant and decreases or ceases during the dry season. Among the three tick species identified as vectors and 'reservoirs' of the disease *Rihipicephalus decoloratus* is prevalent in different parts of Ethiopia. Lumpy skin disease virus mainly affects all age group and breeds of cattle but the indigenous breeds (*Bos indicus*) such as zebu and zebu hybrids are more likely to have some natural resistance against the virus than high-producing dairy animal *Bos taurus* breeds. A strategic vaccination program before disease outbreak season, further research on the transmission of LSDV and their dynamics in different agro-ecologies, implementation of quarantine system before new animals introduced to the herd, creating regular community awareness and implementation of intensive management system or grazing of the animal when the insect is not active should be implemented to control the disease.

Key words: Economic Importance · Epidemiology · Ethiopia · LSD

INTRODUCTION

Lumpy skin disease is an important cause of mortality and reduced productivity of meat and milk as well as draft, hides and dung fuel. LSD is transboundary emerging list A disease that causes international ban on the trade of livestock and their products [1].

Lumpy skin disease virus (LSDV) is grouped under the family of poxviridae, genus Capripoxvirus and species lumpy skin disease virus (Nettling virus). The virus has only one serotype and it is closely related antigenically to sheep and goat poxvirus [2]. The virus is generally resistant to drying, freezing and thaw. The disease affects all age group and breeds of cattle, however Bos *taurus* are more susceptible than zebu cattle. Some wild species such as giraffe, impala oryx, springbok and gazelle have been infected experimentally [3, 4].

The incidence of LSD is high during wet seasons when biting-fly populations are abundant and it decreases or ceases during the dry season [5-7]. Lumpy skin disease is mainly transmitted by arthropod vectors. The disease is characterized by high fever, enlarged lymph nodes, firm and circumscribed nodules [4, 5]. The disease is diagnosed by characteristic clinical signs, molecular and serological tests such as virus neutralization, agar gel immunodiffusion, Enzyme Linked Immunosorbent Assay (ELISA), western blot, indirect fluorescent antibody test and polymerase chain reaction (PCR). Identification of the agent is done by routine histopathological examination and immune histological staining. The disease should be differentiated from other skin diseases of cattle such as dermatophilosis, pseudo-lumpy skin disease, demodicosis, photosensitization, insect or tick bites, *Hypoderma bovis* infection and ringworm [8, 9].

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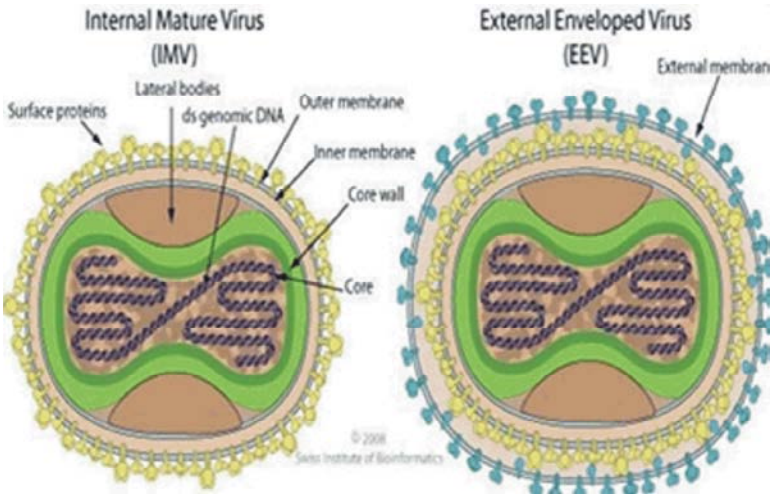

Fig. 1: Morphological structure LSDV
Source: Lefèvre and Gourreau [18]

Lumpy skin disease was one of the newly emerging diseases of cattle first observed in the northwestern part of Ethiopia (Southwest of Lake Tana) in 1983. It is now spread to almost all regions and agro-ecological zones of the country [10]. The current status and occurrence of LSD is associated with the different agro-climatic conditions and the associated risk factors.

The control and prevention strategy of the disease include vaccination, quarantines, livestock movement restriction and control of insect vectors, slaughtering of infected and exposed animals followed by cleaning and disinfection of the premises, awareness campaign to facilitate cooperation from the industry and the community [8, 11, 12].

The economic impact of the disease was determined by an estimation of the direct (Visible) and indirect impacts [13, 14]. In general LSD is considered as a disease of high economic pressure because of its ability to compromise food security through loss of draft power, reduced output of animal production, increase production costs and disrupt livestock and their product trade (Ban or restrictions of international trade of livestock [15, 16]. Even though the disease causes heavy financial loses there was limited research done and given less attention. Therefore, the objectives of this senior seminar paper is to Review the epidemiology and economic importance of lumpy skin disease in Ethiopia.

Etiology: Lumpy Skin Disease Virus is grouped under the family of poxviridae, subfamily Chordopoxvirinae, genus Capripoxvirus and species lumpy skin disease virus (Neethling virus). The virus has only one serotype which is prototype strain of LSDV is the Neethling virus and it is closely related antigenically to sheep and goat poxvirus [2]. LSDV will grow in tissue culture of bovine, ovine or caprine origin, although maximum yield is obtained using lamb testis cells [17]. The members of this family are among the largest of all viruses. It is an enveloped virus, linear ovoid shape with a molecular brick shaped or ovoid virions measuring 220-450 nanometer (nm) by 140-266nm (Figure 1) [18]. LSDV is double-stranded DNA genome of about 151kb [19].

Geographical Distribution: Lumpy skin disease has a different geographical distribution. The disease was first observed in 1929 in Zambia. Initially, it was considered to be the result either of poisoning or a hypersensitivity to insect bites because at that time it was the year when populations of biting insects were greatest. Between 1943 and 1945, cases occurred in Botswana, Zimbabwe (Southern Rhodesia) and the Republic of South Africa. The infectious nature of the disease was recognized at this time [5]. LSD was restricted to countries in sub-Saharan Africa from 1929 to 1986 and it is endemic in most African countries including Madagascar. Since 2012 LSD has been spreading on an unusually large scale throughout Middle Eastern countries as subsequently years was reported from Oman, Yemen, Israel, Kuwait, Bahrain, Egypt, Iran, Saudi Arabia Lebanon, Jordan and in United Arab Emirates, Zeynalova *et al*. [20].

Mode of transmission: The main mode of transmission of LSDV is via arthropod vectors [4]. The three bloods sucking hard tick species such as *Rhipicephalus (Boophilus) decoloratus* (Blue tick), *Rhipicephalus*

appendiculatus (Brown ear tick) and *Amblyomma hebraeum)* (Bont tick), Aedes aegypti mosquitoes and Stomoxys calcitrans flies have been reported to involve in the transmission of LSDV in sub-Saharan Africa. Infected flying insects may be carried short distances by air currents [21]. Among the three tick species identified as vectors and 'reservoirs' of the disease *R. decoloratus* is prevalent in different parts of Ethiopia [22, 23].

The virus is present in all secretions of the infected animal such as blood, nasal and lachrymal secretions, semen and saliva, milk, which may be the sources for transmission. The LSD virus are also present on nodules of the mucous membranes of the eyes, nose, mouth, rectum, udder and genitalia ulcerate are also importance source [24]. Additionally, LSD is transmissible to suckling calves through contaminate milk [18].

Direct contact between infected and susceptible animals is considered an inefficient route of transmission for LSDV. Transmission was, however, achieved when severely infected and susceptible cattle were allowed to share a drinking trough with severely infected animals start to excrete the virus in saliva, ocular and nasal discharges, but further investigations of transmission through direct contact are required [5, 24].

Risk Factor

Host Risk Factor and Susceptibility: The virus mainly affects all age group and breeds of cattle, however Bos *taurus* are more vulnerable to clinical disease than zebu cattle [5, 24]. Fine-skinned *Bos taurus* cattle breeds such as Holstein-Fresian and Jersey develop more severe disease because of their thin skin. Thick-skinned *Bos indicus* breeds including the Afrikaner and Afrikaner cross-breeds show less severe signs of the disease. This is probably due to the decreased susceptibility to ecto parasites [3]. Young calves and cows at peak lactation show more severe clinical symptoms [21].

Even though, the clinical severity of disease depends on susceptibility and immunological status of the thin-skinned, the high-producing dairy animal *Bos taurus* breeds are highly susceptible against LSDV, whereas indigenous (*Bos indicus*) breeds such as zebu and zebu hybrids are likely to have some natural resistance against the virus [6]. It is not known what genetic factors influence the disease severity. Lactating cows appearing to be severely affected and result in a sharp drop in milk production because of high fever caused by viral infection itself and secondary bacterial mastitis [25].

The morbidity rate varies widely depending on the immune status of the hosts (Host susceptibility) and the abundance of mechanical arthropod vectors [26]. An introduction of new animals to the herd was highly associated with the occurrence of LSD [27]. There is no evidence or report that the virus can affect humans [5].

Role of Wildlife: Although the viruses are highly host specific and affect cattle and domestic water buffaloes, some wild species such as giraffe (*Giraffe Camelopardalis*) and impala (*Aepyceros melampus*) are highly susceptible to experimental infection [3]. Suspected clinical disease has been described in an *Arabian oryx (Oryx leucoryx*) in Saudi Arabia, springbok (*Antidorcas marsupialis*) in Namibia and oryx (*Oryx gazelle)* in South Africa and Thomson's gazelle have been infected experimentally [4]. However, the role of wildlife in the epidemiology of LSD in Ethiopia is not well studied [7]. Parenteral inoculation of LSDV develops characteristic lesions. However, under natural conditions, lesions of LSD not been seen on these animals when they have been present during epizootics of the disease [25]. African buffaloes (*Syncerus caffer*) and Asian water buffaloes (*Bubalus bubalis)* do not show lesions in the field during epizootics of LSD but both buffalo types may suffer an unapparent infection [4]. Thus, normally the role of wildlife in the transmission and maintenance of LSDV was found almost negligible [20].

Environmental Risk Factor: The effect of agro climate, communal share of the same grazing and watering points and unrestricted movement of animals across different borders following rainfall were some of the risk factors [25]. Distribution of the disease in various agro climatic conditions, introduction of new animals to the herd and the presence of water bodies are among the other risk factors that would facilitate the spread of outbreaks in various localities. The incidence of LSD occurrence is high during wet seasons when biting-fly populations are abundant and it decreases or ceases during the dry season [6, 7, 28].

Pathogen Risk Factor: The virus is generally resistant to drying, freezing and thawing. Resistance to heat is variable but it is susceptible to 55°C/2 hours or 65°C/30 minutes. It can be recovered from skin nodules and kept at-80°C for 10 years. The infected tissue culture fluid can be stored at 4°C for 6 months. It survives well at cold temperatures [18]. LSDV is very resistant to physical and chemical agent. The virus is susceptible to highly alkaline

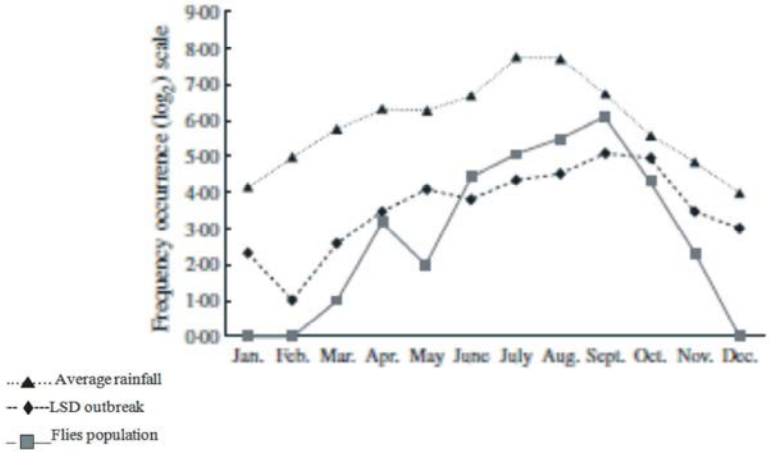

Fig. 2: Seasonal increase in biting-fly activity versus LSD occurrence.
Source: Getachew Gari *et al*. [30]

or acidic PH, ether (20%), chloroform, formalin (1%) and some detergents (sodium dodecyl sulphate). In addition, it is also susceptible to phenol (2% /15 minutes), sodium hypochlorite (2-3%), iodine compounds (1:33 dilution), Virkon® (2%) and quaternary ammonium compounds (0.5%) [25].

The virus persists in necrotic skin for at least 33 days and remains viable in lesions in air-dried hides for at least 18 days at ambient temperature [26]. It may persist for up to six months in a suitable environment, such as shaded animal pens. The virus is also present in nasal, lachrymal and pharyngeal secretions, semen, milk and blood and it may remain in saliva for up to 11 days and in semen for 22 days [29]. There is no evidence of the virus persisting in meat of infected animals, but it might be isolated from milk in early stages of fever [18]. LSD virus may persist for 6 months on fomites, including clothing and equipment but there is no evidence that virus can survive more than four days in insect vectors [21]. It can remain viable for long periods in the environment. Meanwhile, the virus is susceptible to sunlight and detergents containing lipid solvents, while, in dark environmental conditions, such as contaminated animal sheds, it can persist for many months [28].

The Epidemiology of LSD in Ethiopia: Lumpy skin disease is one of the newly emerging diseases of cattle which spread almost all the regions and agro ecological zones of Ethiopia [10, 30]. The current status and occurrence of LSD is associated with the different agro-climatic conditions and the associated risk factors. These risk factors are the effect of agro climate, communal grazing/watering management and introduction of new animals. Ethiopia has two major seasons of rainfall i.e. a shorter rainy season that usually begins in mid-February and continues up to end of April and the long rainy season starting mid-June and ending mid September. This association might be attributed to the availability and abundance of effective mechanical vector insects. The temporal involvement between LSD occurrence and increase in the biting-fly population was positively correlated and significant increase to the occurrence of the disease. Consequently, both biting-flies activity and disease outbreak frequencies begin to increase from April reaching a maximum in September which suggested that mechanical vector insects might play a major role in the disease outbreak of LSD (Figure 2) [12, 30].

Subsequently the potential risk of agro-climate variations to LSD occurrence showed that herds in midland and lowland agro-climates were more likely infected by LSD than in the highland agro-climate. The herd level sero-prevalence was higher in the midland (64 %) as compared to the lowland (50 %) and the highland (26 %) because agro-climate variation is the basis for the type and abundance of considered mechanical vector insects [7]. Therefore, the warm and humid climate in midland agro-climates might be a more favorable environment for the occurrence of large populations of biting flies than highland and lowland agro-climates [30, 31].

The environmental factor of sharing common watering points and grazing plots would allow contact and intermingling of different herds that would probably increase the risk of exposure and enhance the virus transmission through contamination and/or the speculated mechanical vectors such as Stomoxys species and mosquitoes [12, 30].

Table 1: Reported outbreaks of LSD in different regions of Ethiopia from 2007-2011

	Years of reported outbreaks					
Zone	2007	2008	2009	2010	2011	Total
Addis Ababa			3	7	1	11
Afar			3	2	2	7
Amhara	92	68	35	40	22	257
Ben.Gumuz				3	5	8
Gambela				1	9	10
Oromiya	95	154	219	286	160	896
SNNP	18	18	14	32	17	99
Somali		3		9	4	16
Tigray	7	8	2	18	13	48
Grand Total	215	248	279	377	233	1352

Source: Birhanu Admassu [32]

Table 2: Summary of prevalence of LSD in different parts of Ethiopia

Study area	% Prevalence	Reference
Oromia region (Walmera, Ada'a-Barga, Yaya-Gulale, Liben-Chukala, Jimma-Arjo and Seka)	23.67	[6]
Selected districts of West Wollega zone	6.43	[7]
Eastern Wollega of Ethiopia (Guto Gida, Wayu Tuka and Gidaayana Districts)	71.64	[33]
Adama District	6.10	[34]
Central and north-western parts of Ethiopia	21.20	[14]
East Shewa Zone	16.1	[35]
Gondar town	5.65	[36]

Economic impact of the disease: Lumpy skin disease is considered as a disease of high economic pressure because of its ability to compromise food security through loss of draft power, reduced output of animal production and increase production costs due to increased costs of disease control and eradication measures such as vaccination campaigns as well as the indirect costs because of the compulsory limitations in animal movements cause significant financial losses on a national level. Moreover, severe economic losses may be high due to condemnation of carcass and cost of inspecting meat as it damages to the hides [15]. Permanent damage to the skin and hides greatly affect leather industry. It causes ban or restrictions to the global trade of live animals and animal products, costly control [16].

The world organization for animal health (OIE) categorizes the disease as notifiable diseases because of its severe economic losses. The economic importance of the disease was mainly due to having high morbidity rate rather than mortality [25]. The economic impact of LSD was determined by an estimation of the direct (visible) production losses such as milk production, mortality loss, draft power loss, reduced body weight, abortion, culling, temporary or permanent infertility in males and females and poorer hide quality. The indirect impacts of LSD include control costs. LSD control costs consist of vaccination, diagnosis and medication costs and extra labour costs for seeking treatment for sick animals [13,14].

CONCLUSION AND RECOMMENDATION

Lumpy skin disease is one of the newly emerging diseases in Ethiopia which spread almost all the regions and agro ecological zones. The current status and occurrence of LSD is associated with the different agro-climatic conditions and the associated risk factors. Both biting-flies density and disease outbreak increase from April reaching a maximum in September. The disease causes direct (Production losses, condemnation of carcass and hides) and indirect (Disease control and eradication measures) economic loss. Based on the above conclusion the following recommendations are forwarded.

- A strategic vaccination program before disease outbreak season
- Further research is required about the transmission of LSDV and their dynamics in different agro-ecologies.
- Implementation of quarantine system before new animals introduced to the herd.
- Creating regular community awareness that the herd owners should avoid herd mixing and contacts by using private grazing plots and watering sources.
- Implementation of intensive management system or grazing of the animal when the insect is not active.

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