Int. J. Curr. Res. Med. Sci. (2023). 9(6): 50-58

International Journal of Current Research in Medical Sciences

ISSN: 2454-5716

(A Peer Reviewed, Indexed and Open Access Journal)

www.ijcrims.com

Review Article

Volume 9, Issue 6 -2023

DOI: http://dx.doi.org/10.22192/ijcrms.2023.09.06.005

Review on anthrax in animal, human and status in Ethiopia

Mohammed Aliye Tunfuri*[1] and Gadisa Girma Ayano[1]

1 Department of agriculture, Hetosa agricultural office, Arsi, Ethiopia

*[1] Corresponding Author: Mohammed Aliye Tunfuri, Email: *aliyimohammed177@gmail.com.*

Abstract

Anthrax is a soil borne bacterial disease caused Bacillus anthracis. Bacillus anthracis is a spore forming, Gram-positive, rod-shaped and facultative anaerobic bacterium about 1 by 9 µm in size.The host factor of the disease occurs in all vertebrates but is most common in cattle and sheep and less frequently in goats and horses. Humans occupy an intermediate position between this group and the relatively resistant pigs, dogs and cats.In animals, transmission occurs by ingestion and possibly inhalation of spores, although entry through skin lesions has not been ruled out.Tentative diagnosis of anthrax is based on the case history, epidemiology of the disease, clinical signs and necropsy findings (this should be done with precautions). While laboratory diagnosis gives the confirmatory diagnose of the disease.Anthrax infection in humans has been categorized into two; Agricultural and Industrial. Agricultural cases occur when people come in contact with tissues from infected or death animals accidentally or during slaughter. These include veterinarians, butchers, slaughterhouse workers and even ranchers. On the other hand, Industrial cases are those that occur during cleaning and processing of infected animal products.Anthrax is endemic in most species of domestic animals and also cases have been commonly reported in humans in Ethiopia, very few studies are officially confirmed.The disease can be treated by commonly available antibiotics. Rapid identification and treatment of affected animals and humans, vaccination, quarantine, disinfection of premises and disposal of infected materials are commonly recommended control and prevention measures of anthrax.

Keywords: Anthrax, Animal, Human, Status, Ethiopia

Introduction

Ethiopia has a large livestock population and many rural communities depend on animals for food, income and draught power. Disease is one of the major constraintspreventing these large livestock resources from beingfully exploited. Anthrax is a soil borne bacterial disease caused Bacillus anthracis. Bacillus anthracis is a spore forming,Gram-positive, rod-shaped and facultative anaerobic bacterium about 1 by 9 µm in size(Eshete et al., 2017).

Anthrax is virtually a disease of all warm-blooded animals, including humans. The name 'anthrax' is derivedfrom the Greekword,' anthrakos', meaning coal, referring to the characteristic eschar in the human cutaneous form of the disease. Soil contaminated by sick animals that expel the organism together with feces, urine and different

discharges are important source of the infection. Bacillus anthracis can be found naturally in soil and commonly affects domestic and wild animals around the world. It occurs in animals (cattle, sheep, goat, horse), which are susceptible to the organism. Pigs, dog and cats relatively resistant and birds are highly resistant. Humans usually become infected when they come into contact with infected animals or their products(Mohammed, 2018).

Anthrax is found all over the world on all continents except Antarctica. But it is common in parts of Africa, Asia and the Middle East where control measures inanimals are inadequate. Diagnosis of anthrax is based on the case history, epidemiology of the disease, clinical signs and laboratory examination. The disease can be treated by commonly available antibiotics. Rapid identification and treatment of affected animals and humans, vaccination, quarantine, disinfection of premises and disposal of infected materials are commonly recommended control and prevention measures ofanthrax(Yadeta & Jilo, 2020).

In Ethiopia anthrax is endemic diseases affecting both animal and humans, therefore the objective of this review is

- ✓ To understand the status of the diseases in Ethiopia
- ✓ To review the current diagnosis, prevention and control intervention
- ✓ To highlight the Epidemiology of Anthrax in Ethiopia

Review on anthrax in animal, human and status in Ethiopia

Etiology

Anthrax is a disease of microbial origin caused by the bacterium Bacillus anthracis, a Gram-positive, endospores forming rod. It is an aerobic, non-motile that forms centrally located spore. Bacillus anthracis belong to the family Bacillaceae. The first part of bacteria to intact with the host, when it is in its spore form, is the exosporium. It is made mostly of protein, with lipid and carbohydrate component. The vegetative Bacillus anthracis cells contain an extensive peptidoglycan , s-layer protein(Mohammed, 2018).

Epidemiology

Geographical distribution

The disease is found all over the world on all continents except Antarctica. The disease probably originated in sub Saharan Africa and has spread to have a worldwide distribution. There are endemic areas with more frequent outbreaks; other areas are subject to sporadic outbreaks. This area in tropics and sub tropics where there is a continuous epidemic (epizootics) of anthrax is called incubator area of Bacillus anthracis (Blackburn *et al*,2007).

In domesticated animals and people, anthrax is particularly common in parts of Africa, Asia and the Middle East where control measures in animals are that inadequate. It also occurs in South and Central America. This disease is infrequently reported in North America and Europe. In Europe, it is mostly seen in the south, while cases in North America currently occur in limited foci in western and Midwestern U.S. states and in parts of Canada (Aulinger*et al*, 2005).

According to Inter African Bureau for Animal Resources(AU-IBAR, 2011), in 2011,21 member states reported animal anthrax outbreaks toAU-IBAR recording a total of 629 outbreaks, 5655 cases and 1735 deaths. The highest number of outbreaks were reported by Ethiopia (452), followed by Somalia (44) and South Africa (25). The highest number of deaths was also recorded by Ethiopia (1102), followed by Zimbabwe (119),Guinea Bissau (109) and Cote d'Ivoire (103).

Risk factors

1. Host factor

The host factor of the disease occurs in all vertebrates but is most common in cattle and sheep and less frequently in goats and horses. Humans occupy an intermediate position between

this group and the relatively resistant pigs, dogs and cats. In farm animal the disease is almost invariable fatal, except in pig and even in this species the cause fatality rate is high (Misgie *et al*., 2015)

2 Agent factor

The capsule and the toxin complex are the two known virulence factors of B. anthracis. The poly. D. glutamic acid capsule is presumed to act by protecting the bacterium from phagocytosis .The toxin complex, which consists of three synergistically acting proteins, Protective Antigen, Lethal Factor and Oedema Factor is produced during the log phase of growth of B. anthracis. These three components act synergistically to produce the toxic effect seen in bacillus anthraces (Radostits *et al*, 2007)

3. Environmental factor

In tropical and sub-tropical climate with high annual rain falls, the infection persists in the soil, so that frequent, serious outbreak of anthrax is commonly encountered. In some Africa countries the disease occurs every summer and reaches a devastating occurrence rate in years with heavy rainfall. For example, heavy rain after a prolonged drought, or dry summer months after prolonged rain and always in warm weather (Gracy*et al*, 2007)

Transmission

In animals, transmission occurs by ingestion and possibly inhalation of spores, although entry through skin lesions has not been ruled out. Herbivores usually become infected when they ingest sufficient numbers of spores in soil or on plants in pastures. Outbreaks are often associated with heavy rainfall, flooding, or drought. Contaminated bone meal and other feed can also spread this disease.In infected animals, large numbers of bacteria are present in hemorrhagic exudates from the mouth, nose, and anus. When they are exposed to oxygen, these bacteria form endospores and contaminate the soil. Sporulation also occurs if a carcass is opened; however, this process requires oxygen and does not occur inside a closed carcass. Anthrax spores can remain viable for decades in the soil or animal products, such as dried or processed hides and wool. Spores can also survive for two years in water, 10 years in milk, and up to 71 years on silk threads. Vegetative organisms are thought to be destroyed within a few days during the decomposition of unopened carcasses(Distribution, 2007).

Humans usually develop the cutaneous form of anthrax after skin contact with infected animal tissues, such as hides, wool, bone meal, and blood. Experiments in mice suggest that anthrax spores may germinate and enter the skin in abraded, but not intact, skin. Biting flies that feed on infected animals or carcasses may be able to transmit this form mechanically. Inhalational anthrax occurs after inhaling spores from animal products, laboratory cultures, or other sources. Gastrointestinal anthrax results from the ingestion of raw or undercooked meat containing viable spores.Person-to-person is rare and only reported for cutaneous anthrax, where direct contact with skin lesions for infection (Read*et al*, 2003).

Diagnosis

Tentative diagnosis of anthrax is based on the case history, epidemiology of the disease, clinical signs and necropsy findings (this should be done with precautions). While laboratory diagnosis gives the confirmatory diagnose of the disease. In epidemiological diagnose of the disease, species of animals that are affected in the area, sudden death of animals in pasture in endemic areas after agricultural activities and flooding should be considered. In clinical signs, per acute and acute nature of the disease in most cases with septicemia and/or carbuncle and angina on affected animals should be considered (Berg *et al*, 2006).

In animals, rapid diagnostic methods require testing the carcass while it is still fresh. Once the carcass carcass is putrefied or scavenged, culture is required to isolate B. anthraces. Samples should be collected without opening the carcass. Specimens can include blood, tissue, exudates, other fluids and nasaturbinates (Radostits*et al*, 2007). In humans Specimens can include blood,

skin lesion exudates, pleural or ascitic fluid, cerebrospinal fluid, or stool. Specimens should always be collected prior to antibiotic therapy. Culture and Gram stains will likely be negative if specimens are collected after antibiotic therapy has been initiated, regardless of the form of disease.The likelihood that antigen or molecular testing methods will be positively decreased with the length of antibiotic treatment prior to sample collection (WHO, 2008).

Table 1: Diagnosing tests

Available tests		Findings
	Gram stain	Gram-positive rods, square-ended, in pairs or short chains
	Polychrome methylene blue stain (M'Fadyean stain)	Dark blue square-ended rods surrounded by pink capsule. Rods are in pairs or short chains, sometimes as single rods
	Direct antigen detection	Detection of antigen (usually protective antigen, but test will specify)
	Serology	Seroconversion (use as a retrospective diagnosis, as need paired sera collected at least 2 weeks apart)
	PCR	Detection of toxin and capsule DNA
	Culture (Gold standard)	Identification of *B. anthracis* by: colonial morphology, non-motile, non-hemolytic, gamma phage and penicillin-sensitive, and capsule producing

Source: For laboratory diagnostic criteria, see OIE/WHO/FAO. 2008. Anthrax in Humans and Animals, 4th edition. Page 118.

Treatment

Bacillus anthraces are susceptible to penicillin, chloramphenicol, streptomycin, tetracycline and erythromycin. Treatment should continue for at list five days. However, in acute anthrax, antimicrobial treatments often useless (Hirsh et al, 2003). If a human is known to be exposed to anthrax, they should be promptly treated with prophylactic antibiotics. This is especially crucial in case of pulmonary (inhaled) anthrax, which is often fatal if not treated (Mohammed, 2018).

Control and Prevention

Rapid Identification and Treatment of Affected Animals and Humans: In enzootic countries or areas, whether or not animal vaccination is carried out, all suspected sudden deaths in animals should be investigated as possible cases of anthrax. Flocks or herds in direct or indirect contact with positive human cases should be investigated, as the human infection will have derived from animal cases and any infected herds or flocks should be identified. Prophylactic administration of a single dose of long acting tetracycline or penicillin is a much commoner tactic to susceptible animals. For outbreak of the disease in humans; Rapid identification of animal source of outbreak,persons exposed to source, Outpatient treatment of uncomplicated cutaneous cases, Provision of antibiotics and supportive care for systemically ill patients should be considered(Misgie*et al*., 2015).

In livestock, anthrax can be prevented largely by vaccination of all grazing animals in the endemic area and implementation of control measures during epizootics. Vaccination should be done 2-4 weeks before the season when outbreaks may be expected. In Ethiopia anthrax vaccine is being produced by National veterinary Institute (NVI, 2016).

Anthrax is a reportable disease. Quarantines, effective carcass disposal techniques, and decontamination can help prevent dissemination during outbreaks. Sick animals should be isolated. To prevent sporulation, carcasses should not be opened. Scavengers should also be prevented from accessing the carcass. Local regulations determine carcass disposal; however, incineration is considered to be the most effective disposal method for carcasses, contaminated manure, bedding, and other materials. Deep burial may also be used, but is less desirable. Barns, pens, and equipment should be cleaned and disinfected. Once the soil has been contaminated by spores, it is very difficult to decontaminate; however, procedures such as soil removal and/or treatment with formaldehyde may be used in some circumstances. Insect repellents help prevent flies from spreading the organism. If a pet has been exposed to anthrax, the fur should be decontaminated by repeated bathing to mechanically remove the organism (Distribution, 2007).

Public health importance

Anthrax infection in humans has been categorized into two; Agricultural and Industrial. Agricultural cases occur when people come in contact with tissues from infected or death animals accidentally or during slaughter. These include veterinarians, butchers, slaughterhouse workers and even ranchers. On the other hand, Industrial cases are those that occur during cleaning and processing of infected animal products. Inhalational and cutaneous forms have been reported due to exposure to contaminated hair, wool, hides and skins, therefore persons working in industries processing these materials are at risk of exposure to anthrax spores. Industrial cases consisted of 65% of all the cases encountered during the period 1955-1999 and reported to CDC (Bischof*et al*, 2007).

In humans, three forms of the disease can be manifested depending on the route of infection.cutanous forms of anthrax this is the most commonly encountered form comprising of upto 90% of all the human cases. It is characterized by popular skin lesion, which is black (coal-like) with necrotic center surrounded by fluid-filled vesicle. The center ulcerates and dries up forming a black scab, a lesion that is usually painless. Regional lymphadenopathy, swelling of the face and neck may be apparent. Secondary infection may result in pain, fever and pus production from the lesions. These cases resolve often spontaneously with early treatment and fatalities occur in approximately 5-20% of untreated cases and less than 1% of treated patients (Avashia *et al*, 2007).

Gastrointestinal anthrax is the second commonly occurring form that develops after consuming contaminated meat. The spores penetrate the intestinal epithelia and germinate resulting in ulcerative lesions leading to obstruction, hemorrhage, or perforation. The symptoms may be mild including fever, malaise, vomiting,

anorexia and diarrhea. Acute onset may follow with hematemesis, severe abdominal pain, massive ascites and bloody diarrhea that may progress to shock, coma and death. Case fatalities ranges from 60-75% with treatment significantly lowering fatalities (Botswana, 2011).

Inhalational anthrax is the most fatal and rare form of infection. It is due to inhalation of anthrax spores in the environment and commonly associated with industrial exposure (woolsorters' disease) or bioweapon. Symptoms develop gradually and are usually non-specific. Initial signs include malaise, fever, lethargy, weakness and dry cough with mild chest pain. The symptoms improve with time but prodromal phase ends with onset of acute dyspnea, tachycardia, cyanosis, stridor and fatal septicemia. Case fatality has been estimated at 90-100% of patient at the fulminate stage regardless of treatment (Hilleman, 2002)

Status of anthrax in Ethiopia

Anthrax is endemic in most species of domestic animals and also cases have been commonly reported in humans in Ethiopia, very few studies are officially confirmed. In last year, from January to June 2018, Ethiopia has reported 40 outbreaks in different species of animals with1222 cases (OIE, 2018).According to the Federal Democratic Republic of Ethiopia, Ministry of Health surveillance data,In the Ethiopian fiscal year 2003, a total of 1,096 suspected human anthrax cases and 16 deaths with a Case Fatality Rate (CFR) of 1.5% were reported from four regions(Tigray, Amhara, Oromia and SNNPR).

The federal ministries of health and agriculture surveillance data of Ethiopia (2009–2013) reported a total of 5197 human and 26,214 animal anthrax cases. The highest human cases of 6.7 and 2.3% per 100,100 populations were reported from Tigray and Amhara regions, respectively. About 2602 anthrax cases and 18 deaths were reported from Amhara region between 2010 and 2014; 50.6% of the cases and 33.3% of the deaths were from Wag-HimraZone (Bezabih*et al*, 2014).

The cultures of raw meat consumption combined with the low level of awareness about anthrax have increased the risk for contracting the disease in Ethiopia (Tesfaye et al,2013). Additionally, most of the people of Wag-Himra support their life by cattle, sheep and goat husbandry which potentially exposes them to anthrax due to close contacts with livestock, use of hides and skins for different purposes and the consumption of the meat of animals that died from unknown cases with their families and neighbours (Bezabih *et al*, 2014)

In EluAbabor, Western Ethiopia, During the year2009-2016, retrospective data results revealed that a totalof 405(0.028%), 1166(.083%) and 739(.05%) anthrax outbreak, cases and deaths in cattle were respectively registered in the Veterinary Epidemiology department at zone level and veterinary clinics in each Woreda. The hot dry season accounted for 29.6% of the outbreaks followed by the rainy and cold dry season (24.69%) and the post-rainy season recorded the lowest (20.99%) (Eshete*et al*., 2017).

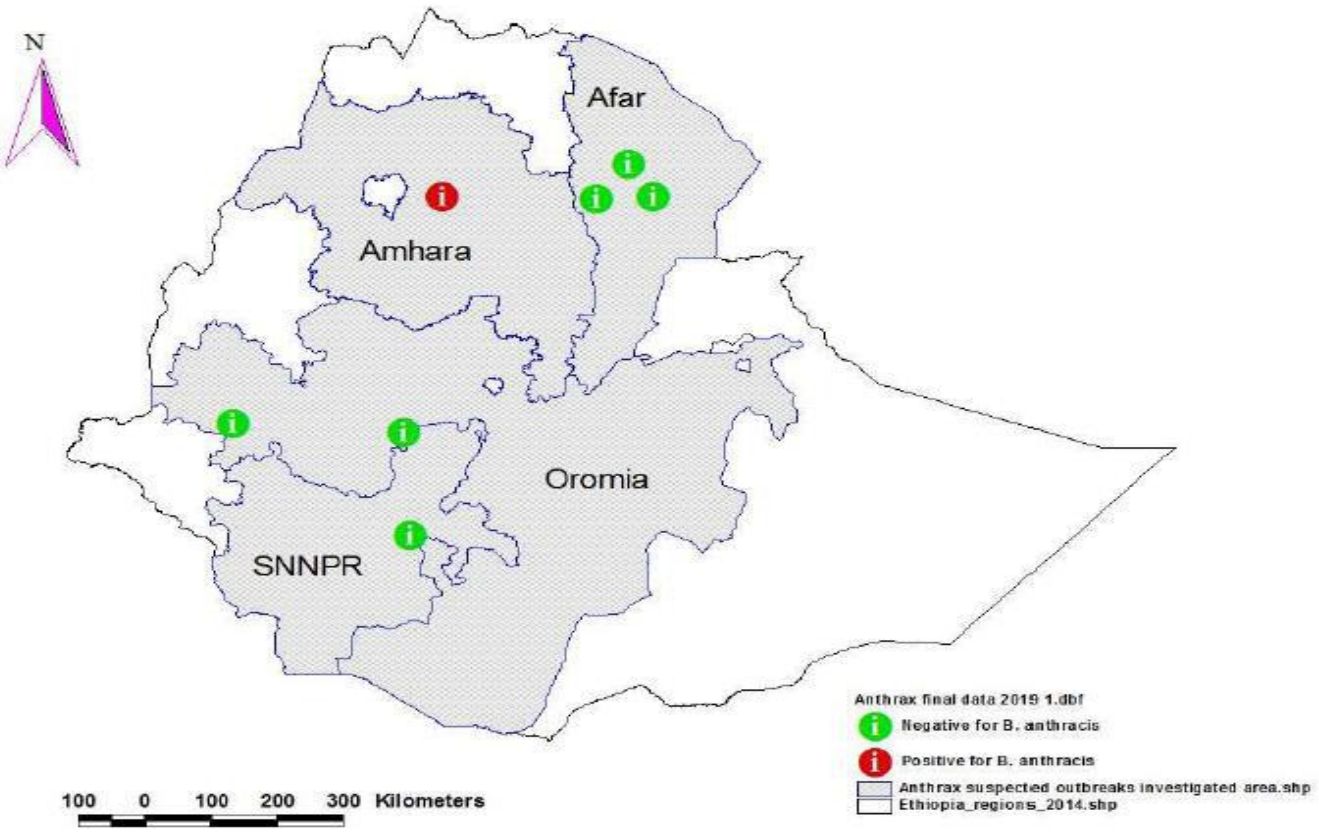
According to Mebratu et al. retrospective data results from in and around Tanqua-Abergelle district, Northern Ethiopia have indicated that a total of 504 anthrax cases were registered in cattle in the veterinary clinics and 2,680 human anthrax cases were recorded in the human hospital/clinics from the year 2008 to 2012.

Table 4: Animal and human anthrax cases and deaths reported in different parts of Ethiopia.

Year	Animal		Human		References
	Cases	Death	Cases	Death	
2018	NR*	NR*	38	1	EPHI, 2018
2009-2016	1166	739	NR*	NR*	Eshete *et al*., 2017.
2010–2013	NR*	NR*	8	1	Perez-Tanoira *et al*., 2017
2009-2013	26737	8523	5197	86	Bahiru *et al*., 2016
2011-2012	NR*	NR*	3	0	Gelaw and Asaminew, 2013
2002	26	26	6	3	Shiferaw, 2004
Total	27,929	9,288	5,250	91	

* NR-Not reported

Source: AbebeOlani, 2019-MSc thesis



Source: AbebeOlani, 2019-MSc thesis

Conclusion and Recommendations

Anthrax is a soil born disease which affects many species of animals, including human and endemic in both developing and developed countries of the world. The disease causes a great problem of the death of animals, reducing animal products and complete condemnation of carcasses and byproducts as well as closure of abattoirs. The organism form spores that help to persist in the environments for a longer period of time, outbreaks are usually associated with flooding or soil disturbance. Diagnosis of the anthrax disease is done on the basis of clinical history, clinical signs, post-mortem findings and laboratory examination of clinical specimens. Anthrax is treated by using antibiotics. Vaccination, Quarantine, disinfection of premises, prophylaxis and proper carcass disposal are important prevention and control strategy against the disease. Although the disease is endemic and causing a series effect in animal and human population in Ethiopia.

Based on the above conclusion, the following recommendations are forwarded:

- ✓ Don't open the carcass ofan animal died anthrax.
- ✓ Burning or burring of suspect and confirmed cases
- ✓ Rapid diagnosis and treatment of sick animals with effective antibiotics
- ✓ A regular and strategic vaccination should

References

Distribution, G. (2007). *Geographic Distribution*. 1–8.

Eshete, T., Chali, G., Wakshum, T., Tafa, S., Husen, M., & Deneke, Y. (2017). *Retrospective Study on the Epidemiology of Bovine Anthrax in Elu Aba Bor Zone , South West Ethiopia*. *19*(4), 590–595. https://doi.org/10.5829/idosi.gv.2017.590.595

Misgie, F., Atnaf, A., & Surafel, K. (2015). *A Review on Anthrax and its Public Health and Economic Importance 1*. *4*(3), 196–204. https://doi.org/10.5829/idosi.ajad.2015.4.3.96127

Mohammed, A. (2018). *SM Gr up Anthrax and Its Public Health SM Journal of Public Health and Importance*. *4*(1), 1–7.

Yadeta, W., & Jilo, K. (2020). *Recent Understanding of the Epidemiology of Animal and Human Anthrax in Ethiopia with Emphasis on Diagnosis , Control and Prevention Interventions- Review*. *May*. https://doi.org/10.5829/idosi.wjms.2020.01.09

Blackburn, J.K., K.M. McNyset, A. Curtis andM.E. Hugh-Jones, 2007. Modeling the geographicdistribution of Bacillus anthracis,thecausativeagent of anthrax disease, for the contiguousUnited States using predictive ecologic nichemodeling. The American JournalMedicine and Hygiene, 77(6): 1103-1110.

Aulinger, B.A., M.H. Roehrl, J.J. Mekalanos, R.J. Collier and J.Y. Wang, 2005. Combining anthrax vaccine and therapy: a dominant-negative inhibitor of anthrax toxin is also a potent and safe immunogen for vaccines. Infection and Immunity, 73(6): 3408-3414.

AU-IBAR, 2011.Panafrican animal health yearbook 2011

Read, T.D., S.N. Peterson, N. Tourasse, L.W. Baillie, I.T. Paulsen, K.E. Nelson, H. Tettelin, D.E. Fouts, J.A. Eisen, S.R. Gill and E.K. Holtzapple, 2003. The genome sequence of Bacillus anthracis Ames and comparison to closely related bacteria Nature, 423(6935): 81-86.

Radostits, O.M., C.C. Gay, K.W. Hinchcliff and P.D. Constable, 2007.A textbook of the diseases of cattle, horses, sheep, pigs and goats. Veterinary Medicine, 10: 2045-2050.

Gracy CC, Radostits OM, Blood DC. A text book of Veterinary Medicine, 8th ed. BaillerTindall.2004; 673.

OIE, 2018. Anthrax, Animal health in the World, Information on aquatic and terrestrial animal diseases: Available online: Anthrax%20 OIE-World Organisation for Animal Health.html Pediatrics, 2009 pp: 211-214.

Bezabih B, Ota M, Abraham A, Teklehaymanot G. Anthrax surveillance data analysis for one health approach intervention. Ethiopia: Amhara region; 2014.

Tesfaye D, Fekede D, Tigre W, Regassa A, Fekadu A. Perception of the public on the common zoonotic diseases in Jimma, Southwestern Ethiopia. Int J Med Med Sci. 2013;5(6):279–85

Esthete, T., G. Chali, T. Wakshum, S. Tafa, M. Husen and Deneke, 2017. Retrospective Study on the Epidemiology of Bovine Anthrax in Elubabur Zone, South West Ethiopia, Global Veterinaria 19(4): 590-595,

Mebratu, A.T., Z. Hailu and Y.H. Weldearegay, 2015. A retrospective survey and assessment of farmer's Tanqua-Abergelle District, Northern Ethiopia. Academic Journal of Animal Diseases, 4(1): 10-16.

Berg, T., H. Suddes, G. Morrice and M. Hornitzky, 2006. Comparison of PCR, culture and microscopy of blood smears for the diagnosis of anthrax in sheep and cattle. Letters in Applied Microbiology, 43(2): 181-186

World Health Organization, 2008. Anthrax in humans and animals, 4 edition, WHO press, Geneva, Switzerland

Hirsh, D.C. and Y.C. Zee, 2003.Veterinarymicrobiology. USA: Black well science, pp: 246-249.

Fouet A, Mesnage S, Tosi-Couture E, Gounon P, Mock M. Bacillus anthracissurface: capsule and S-layer. J Appl.Microbiol.1999; 87: 251-255.

National veterinary institute, 2016. Product catalogue,user manual for anthrax vaccine, document no: nvi-qms-qf- 64(2).

Bischof TS, Hahn BL, Sohnle PG, "Characteristics of spore germination in a mouse model of cutaneous anthrax," J Infect Dis 195:888-894, 2007.

Avashia SB, Riggins WS, Lindley C, Hoffmaster A, Drumgoole R et al. "Fatal pneumonia among metalworkers due to inhalation exposure to Bacillus cereus containing Bacillus anthracis toxin genes," Clin Infect Dis. 44:414-416, 2007

Botswana B. "Vultures curb spread of disease. Gaborone, Botswana," BirdLife Botswana; 2011.

Hilleman, M. "Overview: cause and prevention in biowarfare and bioterrorism," Vaccine. 20: 3055-3067, 2002

Access this Article in Online

Website: www.ijcrims.com

Subject: Veterinary Sciences

Quick Response Code

How to cite this article:
Mohammed Aliye Tunfuri and Gadisa Girma Ayano. (2023). Review on anthrax in animal, human and status in Ethiopia. Int. J. Curr. Res. Med. Sci. 9(6): 50-58.
DOI: http://dx.doi.org/10.22192/ijcrms.2023.09.06.005