Academic Journal of Animal Diseases 10(1): 01-09, 2021
ISSN 2079-200X
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DOI: 10.5829/idosi.ajad.2021.01.09

A Review on: Epidemiology of Bovine Tuberculosis in Ethiopia

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Abstract: Bovine Tuberculosis is a chronic bacterial disease of animals and humans caused by slowly growing bacilli, members of the *Mycobacterium tuberculosis* complex. The disease is characterized by the formation of granulomas in tissues and organs, more significantly in the lungs, lymph nodes, intestine and kidney including others. The disease is transmitted between animals primarily by inhalation although transmission through ingestion is also common in cattle grazing on pasture contaminated with *M. bovis*. Infection in humans is primarily through close contact with infected cattle or consumption of contaminated animal products such as unpasteurized milk. Bovine tuberculosis poses an important economic burden to society, linked with losses of productivity of infected animals, international trade of animals and animal products restrictions, control and eradication programs and human health costs. In Ethiopia, the economic impact of BTB on cattle productivity, BTB control programmes and other related economic effects of the disease are not yet well documented or studied. In general, tuberculosis in human can be effectively controlled through BCG vaccination and employment of chemotherapy. The disease has great economic and public health significance and requires urgent attention by all stakeholders.

Key words: Epidemiology · Bovine Tuberculosis · Ethiopia

INTRODUCTION

Bovine Tuberculosis is a chronic bacterial disease of animals and humans caused by slowly growing bacilli, members of the *Mycobacterium tuberculosis* complex. However, *M. bovis* is the most universal pathogen among mycobacteria and affects many vertebrate animals of all age groups including humans although, cattle, goats and pigs are found to be most susceptible, while sheep and horses are showing a high natural resistance. The disease is characterized by the formation of granulomas in tissues and organs, more significantly in the lungs, lymph nodes, intestine and kidney including others [1]. The disease is transmitted between animals primarily by inhalation although transmission through ingestion is also common in cattle grazing on pasture contaminated with *M. bovis* [2]. Infection in humans is primarily through close contact with infected cattle or consumption of contaminated animal products such as unpasteurized milk [3].

Bovine tuberculosis (BTB) is found throughout the world and the disease is more prevalent in most of Africa, parts of Asia and of the Americas [2]. BTB has been eliminated or eradication programs are in progress in several developed countries. Nonetheless, significant pockets of infection remain in wildlife in Canada, the United Kingdom, the United States and New Zealand. In Africa, the disease is widespread in animals. However, the status and risk factors associated with transmission of BTB in multi-host communities have only been documented in only few countries [4].

In Ethiopia, since the report of Hailemariam [5], several fragmented studies ascertain the presence of BTB in the country. Tuberculin skin test survey indicates that the prevalence ranges from 0.8% in extensive rural farming systems that keep Zebu cattle to 50% in intensive husbandry systems [6]. The estimated animal level prevalence ranges from no detection of infection (0%) [7] to 90% [8] at specific localities level depending on the prevailing production systems and breeds of cattle kept. According to Berhanu *et al.* [9] quantitative analysis of study results conforming to preferredreporting items for systematic reviews and meta-analysesestimated pooled prevalence of bovine tuberculosis in Ethiopia to be 5.8%.

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The disease causes significant animal health-induced economic loss and its impacts include reduction in productivity, movement restrictions, screening costs, culling of affected animals and trade restrictions also has a significant public health importance [2]. Direct losses due to the infection become evident by decrease in 10 to 18% milk and 15% reduction in meat production [10]. WHO [11] estimated total TB control costs in Ethiopia at US$14.2 million per year and according toTschopp*et al.* [12] who estimated the economic cost of BTB to be in the range of 75.2 million to 385 million US$ in the rural extensive livestock production and from 500, 000-4.9 million US$ in the urban livestock production systems between the years 2005 to 2011. Its zoonotic implication has also significantly indicated an increasing trend to be of public health hazards [13].

The disease should be controlled urgently for economic and public health reasons. From successful experience in many developed countries, BTB can be controlled only and effectively when there is a strong political and producer support and an appropriate legal framework to enforce control measures. Moreover, control of BTB provides an ideal platform for the One Health approach, which can be operational through adapted approaches for reducing risks of disease transmission, improving surveillance and meat inspection, enhancing community awareness, promoting milk pasteurization at the community level and strengthening inter-sectoral collaboration [14]. Thus, BTB is a great concern in many developing countries and Ethiopia is one of those where BTB is considered a prevalent disease in cattle populations. This paper reviews the epidemiological features of *M. bovis* infection in animals which are relevant to Ethiopia and outlines some recent reports describing the distribution and prevalence of the disease in Ethiopia.

Bovine Tuberculosis

Etiology: *Mycobacteriumbovis* is an intracellular, non-motile, facultative, weakly Gram-positive acid-fast bacillus which belongs to the Mycobacterium tuberculosis complex, group of genetically closely related mycobacteria. The sub-group Mycobacterium tuberculosis complexalso comprises *M. tuberculos*is, *M. africanum*, *M. canetti*, *M. pinnipedii*, *M. microti* and *M. caprae* that are generally regarded as host adapted but with the ability to spill over into other species. *Mycobacteriumbovis* is the primary cause of bovine tuberculosis (BTB). *M. tuberculosis*, *M. africanum, M. caprae* and *M. canettii* are human pathogens. *M. caprae* which causes infection in goats has been initially classified as subspecies of *M. bovis*but was recently recognized as a species on its own. *M. microti* affects rodents and *M. pinnipedii* have been isolated from seals. *Mycobacteriumbovis* has an exceptionally wide range of mammalian hosts and affects all age groups of susceptible hosts of domestic, wild animals and human [15].

Hosts: Cattle are considered to be the main hosts for *M. bovis*, but other domesticated and wild mammals can also be infected. Goats, sheep, camels, dogs and cats are also susceptible to an infection with *M. bovis*, but no transmission from these to other animals has been reported so far [1]. Wildlife hosts are classified as either maintenance hosts or spill-over hosts or dead-end hosts [16].

Method of Transmission: The transmission of BTB between animals is mainly aerogenic, close contact between animals either via aerosol contamination or sharing of feed between infected and non-infected animals are major risk factors for transmission of BTB. Cutaneous infection is by contamination of other primary lesions with tubercle bacilli and congenital transmission is through umbilical vessels to fetus from infected uterus of dam [17]. Calves and humans can also become infected by ingesting raw milk from infected cows [2].

Pathogenesis: Development of overt disease after infection under field conditions may be dependent not only on the number of virulent organisms to which a susceptible host is exposed, but also on the frequency of exposure and route of infection, as well as the general health and immunological status of the animal. Although tuberculous lesions can be found in all parts of the body in cattle infected with *M. bovis*, they are most frequently found in the lungs and in the broncho-mediastinal lymph nodes, most probably in association with air-borne infection. In contrast to human infection, the primary pulmonary lesion in cattle rarely heals spontaneously, but tends to disseminate locally through the natural cavities, such as the bronchi, or more widely via the lymphatic and hematogenous routes. The outcome of the infection, with few exceptions, is a chronic wasting disease of long duration [18].

Diagnosis

Clinical Examination: Tuberculosis is usually a chronic debilitating disease in cattle, but it can occasionally be acute and rapidly progressive. In countries with eradication programs, most infected cattle are identified

early and symptomatic infections are uncommon. In the late stages, common symptoms include progressive emaciation, a low–grade fluctuating fever, weakness and inappetance. Animals with pulmonary involvement usually have a moist cough that is worse in the morning, during cold weather or exercise and may have dyspnea or tachypnea. Also lymph nodes enlarge obstructingblood vessels and air ways and in some case rupture and drain [19].

Tuberculin Skin Test (Immunological Test): The standard method for detection of TB is the tuberculin test, where a small amount of antigen is injected into the skin and the immune reaction is measured [2]. Tuberculin is the name given to extracts of *M. bovis*, *M. tuberculosis* and *M. avium* which are used to test animals in order to identify those animals previously exposed to mycobacterium infection. The common type of tuberculin is purified protein derivative. The common tuberculin test is comparative intradermal tuberculin test [20].

Two sites on the skin of the mid-neck of the animals, 12 cm apart, are shaved and skin thickness is measured in millimeters with digital caliper before the injection of the tuberculin. Aliquots of 0.1 ml of 20, 000 IU/ml bovine purified protein derivatives and 0.1 ml of 25, 000 IU/ml avian PPD is injected in to the dermis at these sites. After 72 hrs, the thickness of the skin at the injection sites is again measured.The reasons for its wide use are low costs, high availability and long history of use and, for a long time, the lack of alternative methods to detect BTB. Still, this test has many known limitations including difficulties in administration and interpretation of results, need for a second-step visit, low degree of standardization and imperfect test accuracy [21].

Post Mortem and Histopathological Examination: BTB is characterized by the formation of granulomas where bacteria are located. These granulomas are usually yellowish and either caseous, caseo-calcareous or calcified and often encapsulated. Some tubercles are small enough to be missed by the naked eye, unless the tissue is sectioned. In cattle, tubercles are found in the lymph nodes, particularly those of the head and thorax. They are also common in the lung, spleen, liver and the surfaces of body cavities [22].

Bacteriology: *M. bovis* ishard to detect either directly in clinical sample from live animals or by growing it in the laboratory. Therefore, techniques looking directly for the organisms or its DNA, such as culture or polymerase chain reaction are insensitive. Hence, primary diagnostic tests for *M. bovis* rely on detecting the immune response of the host to the organism usingskin tests and gamma interferon Examination of smears prepared from sputum, tissue, milk, urine and other samples taken from suspected individuals are stained with Ziehl-Neelsen staining method and organisms appear as red due to their acid-fast property [15].

The definitive diagnosis of tuberculosis depends on the isolation and identification of the bacteria in specimens taken from suspected individuals and cultured in Lowenstein-Jensen media. This media is composed of coagulated egg, potato meal, bone marrow infusion, citrate, glycerol and malachite green. The addition of glycerol suppresses growth of *M. bovis* but stimulates other mycobacteria [23]. Malachite green inhibits growth of bacterial contaminants and provides a green background against which colonies of mycobacterium are clearly visible. Stone brink's media is another commonly used culture medium for the isolation of *M. bovis* where the glycerol in Lowenstein-Jensen medium is replaced by 0.2% pyruvate to enhance growth of *M. bovis* [24].

Bovine Tuberculosis Risk Factors: Risk factors of BTB aredivided in to animal level risk factor and herd level risk factor. At animal level; Age, breed, body condition, immune status, genetic resistance & susceptibility to BTB, vertical and pseudo vertical transmissions and auto-contamination are considered to be risk factors. Risk factors at herd level are history of BTB outbreak, human antecedent of TB in the house hold, herd size, type of cattle enterprise, management, lack of performance of diagnostic tests, reduced opportunity of detection, introduction of purchased cattle in the herd, movements of animals, other domestic species, contact between animals, wild life and climate influence [25].

Individual Animal Level: Risk of BTB increases with age and increases with decreasing body condition but sex, lactation status and reproductive status were not related with BTB status This suggests that BTB prevalence increases with age, as the duration of exposure to the agent increases with age and animals with poor body condition and low immune status are more likely develop the infectionwith *Mycobacterium bovis*, explaining as such the relation between poor body condition and BTB prevalence [14].

Breed is another factor in which Zebu (Brahman) type cattle are thought to be much more resistant to BTB than European breeds and the effect on these cattle are decreased as being much less severe. However, under intensive feedlot conditions a morbidity rate of 60% and

a depression weight gain can be experienced in infected Zebu cattle. In Ethiopia reported high prevalence (55%) in pure Holsteins than in cross breeds which is relatively low (23%) on dairy farms around DebreZeit [26].

Herd Level: Herd size is one risk factor as there are more animal on a farm, the greater the probability that one of them will acquire the infection. Large herds generally graze on a larger area, with a higher probability to have more contiguous herds, thus increasing the risk of disease spread [14]. Introduction of an infected animal (exchange and purchase of animals) in a BTB free herd or area is one of the major risk factors for introducing the disease [27] the prevalence of the disease is higher in agro-pastoral than in pastoral production systems, probably because of the closer contact between cattle and the more humid conditions in agro-pastoral systems [28].

Host movement has been repeatedly identified as one of the major risk factor for BTB transmission. This specific factor has a major impact if animals are moved from an endemic zone to a BTB free one. In pastoral areas of Africa, the grazing strategy relies on the movement of livestock to follow grazing and water resources over considerable distances following seasonal changes, which would increase the likelihood of both direct and indirect transmission of BTB.When cattle herds move more, the probability of sharing water holes and grazing areas with other infected animals increases and the probability of close contact between infected animals also increases, which results in transmission of BTB [14].

Increasing evidence suggests that wildlife maintenance hosts play an important role in transmission BTB to other animals [4]. In, Africa, wildlife species share resources with pastoralist livestock and this may influence the prevalence of BTB in cattle by having direct or indirect contact (i.e., ingestion of contaminated pastures) with cattle [29]. The probability of contact with wildlife was confounded with herd size, through herd movement. Pastoralists with larger herds moved more and grazed in larger areas, hence the probability of grazing in an area with BTB wildlife maintenance host and contact with either infected cattle or infected wildlife hosts increased, in turn enhancing the chances for BTB infection. [14]. However, data on prevalence of infection in wildlife are often scarce and estimates based on convenience sampling (such as road-kills or hunter-harvest) are subject to biases [30].

Changes in land use and associated ecosystem change have been described as one of the casual drivers in the current emerging and re-emerging of infectious diseases. Land use can be the result of the introduction of invasive species, could potentially influence BTB prevalence through direct effects on the host community composition, host densities and host contact networks. *M. bovis* has been detected in soil samples in East Africa and experimental studies have confirmed that the bacteria can survive for multiple days outside hosts [31]. The major factors influencing survival of the bacteria in soil is soil temperature and moisture, as high temperature causes desiccation and negatively influences survival of the bacteria. Humid areas are also potential risk factors and soils with higher levels of moisture and shade offer favorable conditions for *M. bovis* survival [14].

The other risk factor is demography, socio-economic status and feeding habits. In Ethiopia, from the total population, about 85% of thepeople are engaged in agriculture. To this effect, veryclose contact with potentially infected animals may behigh, which eventually leads to exposure of the BTBinfection. For the urban residents, milk is considered asthe main source of BTB infection, while abattoir workersand farmers are predominantly exposed to the aerosolinfection as a result of close contact with infected animals [32]. All these causalities and/or habits are the dailypractices most notably of rural communities in Ethiopia. Inparticular, milk borne infection is the main cause ofnon-pulmonary tuberculosis in areas where BTB iscommon and uncontrolled. Professional occupationor workers such as, abattoir workers, veterinarians andlaboratory technicians, animal care taker in zoos and thosewho are working in animals' reservations and at nationalparks can also acquire the infection in due course ofregular work [3]. Furthermore, demographic factorssuch as income, education, age, number of family, numberof individuals dwelling per km2 and sanitation etc. are alsocontributing to the epidemiology of BTB. Moreover, reports indicated that infants are more vulnerable tofood-borne *M. bovis* infection, whereas older individualsaverting BTB may occur as a result of endogenous reactivation [33].

The Impact of Animal Production Systems on Bovine Tuberculosis Prevalence in Cattle: The livestock production systems in Ethiopia basically fall into three categories according to the mode of animal husbandry and/or the production system, as well as the use of livestock products. These production systems include [34]:

Integrated Extensive And/or Pastoral Production System: In Ethiopia, the extensive production system ("two categories"), that are mainly practiced as the integrated extensive husbandry system (more in the

highland areas) and the pastoral production systems (in the lowland areas) of the country. Although, the highland areas hold a large number of livestock populations, the cattle breeding are a secondary activity to diversify the crop production. Thus, animals are reared and managed traditionally for draught power purpose. On the other side, the lowland areas where the pastoral production system is predominant, animals are the main source of beef, goats, camel meat and milk products to the nation including for export earnings [34].

In both production systems drinking raw milk is a common practice, in rural areas in particular, which may expose the community to contagious diseases most notably BTB. Regrettably, in this production system, despite the presence of a huge livestock population, the actual prevalence of BTB is not yet known. Difficulties in sampling techniques and animal handling, combined with inadequate veterinary infrastructures are factors that hamper the process of the study However; Prevalence of bovine tuberculosis detected by tuberculin skin test in a traditionally managed extensive production system is 0.3%in Asella [12].

Small Holder Production System: The small holder production system is dominantly practiced in highland areas near towns where dairy animals are reared for subsistence and/or commercial milk production purposes. Under this production system, prevalence studies on BTB have not been conducted adequately, although some cross-sectional studies have been undertaken. Among few conducted studies the prevalence rate of BTB ranges from 3.5% inAsella [26] to 16.2% in Wolaitasodo [35].

Intensive Production System: Although some few intensive feedlots exist, dairy production is the major practice of this system, which is targeted for the production of milk and milk products. The total number of the cattle population under this production system is insignificant compared to the national livestock population; however, it is the main source of milk for the city dwellers. Unlike other production systems, better prevalence studies have been undertaken and frequently incidences and higher prevalence rates of BTB have been observed. Based on the undertaken tuberculin skin tests, in different intensive dairy farms, a prevalence rate ranges from, 6.8% [6]in Sabbata to 73.6% [36] in Dessie.

Recent Reports in Distribution and Prevalence of BTB in Ethiopia: Ethiopia is one of the nations that possesses the largest livestock population in the African continent with an estimated 56.7 million cattle, 29.3 million sheep, 29.1 million goats and 9.86million equines, 1.2 million camels and 56.7 million chicken [37]. The distribution and the quantity of each species is different according to the type of prevailing animal production systems and agro-ecological zones. In contrast to the huge livestock resource, the livestock productivity is, however, found to be very low. The major biological and socio-economical factors attributing to the low productivity includes: the low genetic potential and performance, poor nutrition (in quality and quantity terms), the prevailing of different diseases, traditional way of husbandry systems and inadequate skilled manpower among others [38].

Ethiopia is one of the African countries where BTB is considered protruding disease in animals and its detectionis carried out most commonly on the basis of tuberculin skin testing, abattoir meat inspection and rarely on bacteriological techniques. Several prevalence studies have been performed recently that show BTB is endemic in cattle in Ethiopia.However, prevalence varies depending on the geographical areas, breeds and husbandry practices. Tuberculin skin test survey indicates that the prevalence ranges from 0.8% in extensive rural farming systems that keep Zebu cattle to 50% in intensive husbandry systems [6]. The estimated animal level prevalence ranges from no detection of infection (0%) [12] to 90% [8] at specific localities level depending on the prevailing production systems and breeds of cattle kept. Abattoir and dairy farm studies from central Ethiopia have reported prevalence between 3.5 and 13.5% and locally in peri-urban Addis Ababa up to 50% [39].

Systematic review and Meta-analyses done on articles published on BTB from 2000 to 2016, estimated pooled prevalence of bovine tuberculosis in Ethiopia tobe 5.8%. Many of the studies were conducted in and around urban areas in the central highlands of Ethiopia. In some of the regions likeBenishangul-Gumuz, Somali and Gambela regional states, and sufficient report was lacking [9].

Zoonotic Importance of Bovine Tuberculosis: Zoonoses are defined as those diseases and infections naturally transmitted between people and vertebrate animals. In most cases, animals play an essential role in maintaining the infection in nature and contribute in varying degrees the infection in nature and contribute in varying degrees to the distribution and actual transmission of infection in human and animal populations. These diseases have a variety of transmission mechanisms that may be direct such as in rabies and anthrax or indirect, via vectors food, water and the environment, as in the case of bovine

tuberculosis and cysticercosis. Many, such as brucellosis, also have multiple routes of infection. With the constant and inevitable interaction of man and animals, zoonotic diseases remain a genuine threat to health and survival for people, their livestock, companion animals and wildlife [40].

M. bovis is not the major cause of human tuberculosis, but humans remain susceptible to BTB. Humans can be infected primarily by ingesting the agent by drinking raw milk containing the infective bacilli, secondly, by inhaling infective droplets when there is close contact between the owner and his/her cattle, especially at night since in some cases they share shelters with their animals [2].

The proportion of which BTB contributes to the total of tuberculosis cases in humans depends on the prevalence of the disease in cattle, socioeconomic conditions, consumer habits, practiced food hygiene and medical prophylaxis measures. In countries where BTB in cattle is still highly prevalent, pasteurization is not widely practiced and/or milk hygiene is insufficient, usually it is estimated to be about 10 to 15% of human tuberculosis is considered to be caused by BTB [41]. However, almost all cases of the non-pulmonary type of tuberculosis in humans have been caused due to BTB [42]. In rural areas of Ethiopia most people drink raw milk and do have extremely close attachment with cattle (such as sharing shelter) that intensifies the transmission and spread of BTB.

In Ethiopia, zoonoticimportance of the disease is not well known due to lack of nation-wide investigations [38]. Kiros [43] demonstrated that out of 7, 138 human patients with tuberculosis, 38.4% were found with extra-pulmonary tuberculosis and the proportion of patients with extra-pulmonary tuberculosis was significant in patients who have close contact with cattle and in those who frequently used to drink raw milk in particular. Regassa [35] demonstrated the association of *M. tuberculosis* and *M. bovis* in causing tuberculosis between humans and cattle. The cattle owned by tuberculous patients had a higher prevalence (24.3%) than cattle owned by non-tuberculous owners with 8.6%. The author also noted that 73.8 and 16.7% of 42 human isolates were identified as *M. tuberculosis* and *M. bovis* and from cattle isolates 18.1 and 45.5% of 11 were found to be *M. tuberculosis* and *M. bovis* species, respectively. This showed that the role of *M. bovis* in causing human tuberculosis seemed to be significantly important. On the other hand, in Ethiopia, consuming raw meat is a welcome tradition, thus meat may also remain to be another area of concern or threat to be a source of BTB infection [38].

Economic Importance of Bovine Tuberculosis: Bovine tuberculosis poses an important economic burden to society, linked with losses of productivity of infected animals, international trade of animals and animal products restrictions, control and eradication programs and human health costs [3]. The main productivity losses in cattle are reduced milk and meat production. Milk productivity of total livestock is lower compared to that of non-infected cows. Losses in meat production are divided into losses in beef processing caused by emergency/illness slaughter and losses in processing caused by normal slaughter and reduction of increment meat production [10]. The disease is an obstacle to socio-economic development; 75% of people affected by TB are within the economically productive age group of 15-54 years. This may have a negative influence on the national economy [44].

In Ethiopia, the economic impact of BTB on cattle productivity, BTB control programmes and other related economic effects of the disease are not yet well documented or studied. Few abattoir meat inspection surveillances have shown the condemnation rate of the total or partial carcass and organs [10]. Shitaye *et al*. [45] indicated that, in both Addis Ababa and Debre-Zeit abattoirs tuberculous lesions that, causes condemnation of carcasses and/or organs have also been found to be highly significant economically.

Control of Bovine Tuberculosis

Control in the Cattle Populations: Animals with tuberculosis must be slaughtered (culled);hygienic measures to prevent the spread of infection should be instituted as soon as the first group of reactors is removed. Feed troughs should be cleaned and thoroughly disinfected with hot, 5% phenol or equivalent cresol disinfectant. Water troughs and drinking cups should be emptied and similarly disinfected. It is important that calves being reared as herd replacements be fed on tuberculosis- free milk, either from known free animals or pasteurized [1]. A number of new candidate vaccines are currently being tested [2].

In developed countries BTB has nearly been eradicated or drastically reduced in farm animals to low levels by control and eradication programs. In Ethiopia these measures, however, cannot be adopted in practice due to various reasons such as: lack of knowledge on the actual prevalence of the disease, the prevailing technical and financial limitations, lack of veterinary infrastructures, cultural and/or traditional beliefs and geographical barriers, though certain control measures are in place [3].

In general terms, control measures in the traditional extensive production systems are more difficult and complex. This is the virtue of the largenumbers of livestock involved, the mobility of animals (pastoral production) and the social and economic factors involved. In Ethiopia so far, control of BTB through the test-and-slaughter policy is not yet established. Most commonly culling of infected animals (especially in government owned farms)and improving sanitary and hygienic standards in other dairy farms is the actual control measure of BTB infection [3].

Control in the Human Populations: In general, tuberculosis can be effectively controlled through BCG vaccination and employment of chemotherapy. The conventional anti-tuberculosis drugs (isoniazid, rifampicin, pyrazinamide, thiacentazone and ethambutol) are used to control and prevent the spread of the disease. The treatment course can be either short (2 months) or the standard treatment regime (6 to 8 months). Moreover, health education is practicing as one of the pivotal means to control through sensitization and increasing awareness of the community about the epidemiological characters of the disease and other effective measures are being made to ensure better access throughout the country [46].

CONCLUSIONS

Bovine tuberculosis is a chronic bacterial disease of animals and humans characterized by the formation of granulomatous lesion in different organs. The causative agent of this disease is *M. bovis* and is a significant zoonotic disease. From this Review paper it could be concluded that different studied area of Ethiopia showed that there is no uniform distribution with in the country. Even though, the disease is endemic in Ethiopia, there is lack of sufficient of information on the prevalence of disease at national level. The disease has great economic and public health significance and requires urgent attention by all stakeholders. Based on the above conclusion the following points are recommended:

- Further studies should be conducted on the prevalence and distribution of Bovine Tuberculosis in Ethiopia.
- Sound testing and meat inspection should be conducted.
- Improvement of management and hygienic practices.
- At national level, efforts should be taken to control the disease in the animal.
- Creating and developing awareness in the society to improve their feeding habits of food of animal products and animal origin.
- Insuring dairy farms to encourage owners to cull their infected cattle after testing for BTB and other economically important contagious diseases.

Conflict of Interests: All authors have declared that no competing interests exist.

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