

RESEARCH ARTICLES

Anthrax outbreaks and epidemics in Zambia, 1990-2011: A review

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Citation style for this article:

Siziya S. Anthrax outbreaks and epidemics in Zambia, 1990-2011: A review. Health Press Zambia Bull. 2017;1(1) [Inclusive page numbers]

Anthrax is endemic in Zambia. A review was conducted for literature published on the epidemiology of anthrax in Zambia using google, google scholar and PubMed. A total of 7 publications were obtained using search words: anthrax, Zambia, epidemiology, outbreak and surveillance; and of these, 2 were full PubMed Central articles, 4 were abstracts without full articles and one was a citation. In Zambia in 1990, out of 220 human cases of anthrax, 19.1% died; between 1991 and 1998, 7.7% of 248 human cases died; between 1999 and 2007, out of 1790 human cases, 4.6% died; and in 2011, the case mortality rate was 1.2% out of 521 human cases. In Western province of Zambia, the overall cattle:human anthrax ratio was 1:1.47 and a reduction (Slope=0.738, 95% CI [-1.394, -0.083]) in the human case fatality rate was observed between 1999 and 2007. There is scanty information on anthrax in Zambia. The cattle:human anthrax infection ratio was lower than the expected ratio of 1:10 suggesting under-reporting of human cases or good outbreak/epidemic control. A reduction in the case fatality rate indicates good case management. An active surveillance of human cases of anthrax is recommended immediately there is an outbreak of bovine anthrax in order for people to start treatment early and avoid severe forms of anthrax.

Introduction

Anthrax is a disease of public health importance caused by the spore-forming

gram-positive rod bacteria, *Bacillus anthracis* and its spores can remain viable in soil for a long time up to decades [1-5]. Outbreaks of anthrax generally occur after a prolonged hot dry period [6] and low pH [7]. Although there are inconsistencies in reports on effects of season, rainfall, temperature, soil, vegetation, host condition and population density on the epidemiology of anthrax, anecdotal evidence suggests that temperature and rains (or drought) and humidity are primary conditions affecting the seasonal variation of anthrax [8]. Animals are infected when they breathe in or ingest spores found in soil, plants, or water. Similarly, people are infected when they breathe in spores, eat food or drink water containing spores, or get infected when spores enter through broken skin [9].

CDC [10] suggests five forms of anthrax: Cutaneous characterized by a painless skin

lesion with surrounding oedema, fever, malaise and lymphadenopathy; Inhalation characterized by a prodrome resembling a viral respiratory illness, hypoxia, dyspnoea or acute respiratory distress, mediastinal widening or pleural effusion; Gastrointestinal characterized by severe abdominal pain and tenderness, nausea, vomiting, hematemesis, bloody diarrhea, anorexia, fever, abdominal swelling and septicemia; Oropharyngeal characterized by a painless mucosal lesion in the oral cavity or oropharynx, cervical adenopathy, oedema, pharyngitis, fever, and possibly septicemia; Meningeal characterized by fever, convulsions, coma, or Meningeal signs; and Injection among injecting heroin users in which smoking and snorting heroin have been identified as possible exposure routes for anthrax [11]. The most fatal form of anthrax is the inhalation anthrax [12]. Mortality in untreated cutaneous cases can be up to 20% [13-15], 25-60% of untreated gastrointestinal form of anthrax [16,17] and 99% of untreated pulmonary anthrax cases [13,17].

Although antibiotics are not recommended for prophylaxis for fear of developing resistance, these can be given for a short time to persons who have been substantially

exposed to anthrax [6]. The situations in which such exposure would occur include biological warfare and consumption of infected under-cooked meat. Generally, an outbreak of anthrax may be controlled by eliminating the source of infection, disinfection, correct dispose of infected materials and vaccination of exposed domesticated animals.

WHO [6] recommends use of antibiotics with penicillin as a drug of choice for treatment of anthrax. The other antibiotics that can be used in the treatment of anthrax are ciprofloxacin and doxycycline. In addition to the primary antibiotic (penicillin or ciprofloxacin), a supplementary antibiotic (clarithromycin, clindamycin, vancomycin, rifampicin, streptomycin, vancomycin or rifampicin) can be administered for severe cases. Whilst the epidemiology of anthrax worldwide is well known, there is scanty information on the occurrence, its magnitude and factors associated with anthrax in Zambia. The objective of the study was to review literature in order to tie up evidence on the epidemiology of anthrax in Zambia.

Methods

Zambia is a land locked country with three seasons: the rainy season (November to April), dry cool (May to August) and dry hot season (September to October/November). In the dry seasons, animals will congregate around watering holes and graze on short grass, thereby, exposing to spores in the soil. The disease is endemic in the Luangwa valley and Zambezi floodplain. The main source of the disease in the valley is game, while in the floodplain it is cattle [18]. Most livestock (cattle, goats and sheep) are found in Southern, Central, Lusaka, Copperbelt and Eastern provinces and mostly (83% of cattle, 64% of sheep and 97% of goats) reared by traditional farmers [19].

The Ministry of Health [20] adapted the WHO AFRO/CDC definitions for suspected and confirmed cases of anthrax as follows: A suspected case of anthrax is any person with acute onset of a disease characterized by several clinical forms of cutaneous form that is defined as any person with skin lesion evolving over 1 to 6 days from a papular through a vesicular stage, to a depressed black eschar invariably accompanied by oedema that may be mild to extensive; Any person with abdominal distress characterized by nausea, vomiting, anorexia and followed by fever is said to have gastro-intestinal form of

anthrax; Any person suffering from Pulmonary (inhalation) form of anthrax has brief prodrome resembling acute viral respiratory illness, followed by rapid onset of hypoxia, dyspnoea and high temperature, with X-ray evidence of mediastinal widening; and any person with acute onset of high fever possibly with convulsions, loss of consciousness, meningeal signs and symptoms; commonly noted in all systemic infections, but may present without any other clinical symptoms of anthrax is said to have Meningeal anthrax. Meanwhile, a confirmed case of anthrax is defined as a clinically compatible case of cutaneous, inhalational or gastrointestinal illness that is laboratory-confirmed by isolation or *B. anthracis* from an infected tissue or site; or other laboratory evidence of *B. anthracis* infection based on at least two supportive laboratory tests.

Literature was searched using google, google scholar and PubMed. Literature not published in peer-reviewed journals as reports were obtained using google. Published works in peer-reviewed journals was gathered using google scholar and PubMed.

Results

A total of 7 publications were obtained using search words: anthrax, Zambia,

epidemiology, outbreak and surveillance; and of these, 2 were full PubMed Central articles, 4 were abstracts without full articles and one was a citation.

Animals reported to be affected in Zambia by anthrax include: cattle [21-23], hippopotamus, giraffe, buffalo, kudu, elephant, puku, wild dog, waterbuck, impala, wildebeest and hyena [24].

In Western province of Zambia, the overall cattle:human anthrax infection ratio was 1.47 between 1999 and 2007 in Western province of Zambia [23]. However, between 1991 and 1993, a ratio of 0.10 was observed [21]. Table 1 shows the cattle:human anthrax infection ratios. A reduction of the human case fatality rate was observed in Zambia between 1990 and 2011 from 19.1% to 1.2% (Table 2; Siamudaala et al [22];

Munang'andu et al. [23]; Hang'andu et al. [25]). A similar observation was made between 1999 and 2007 in the upper Zambezi floodplain of western Zambia (Slope=-0.738, 95% CI [-1.394, -0.083]) as shown in Figure 1.

Table 2 Cattle:Human ratio by year

<u>Year</u>	<u>Cattle</u>	<u>Humans</u>	<u>Cattle:Human ratio</u>
1991	511	66	1:0.13
1992	111	13	1:0.12
1993	208	0	1:0
1991-1993	830	79	1:0.10
1999	253	262	1:1.04
2000	186	387	1:2.08
2001	129	253	1:1.96
2002	234	280	1:1.20
2003	234	289	1:1.24
2004	114	192	1:1.68
2005	10	74	1:7.40
2006	32	39	1:1.22
2007	24	14	1:0.58
1999 - 2007	1216	1790	1:1.47

The common forms of human anthrax were cutaneous and gastrointestinal.

Munang'andu et al [23] reported that human cases of the cutaneous form were higher than those for gastrointestinal in Western province. Meanwhile, Siamudaala et al [21] found that gastrointestinal was more common than cutaneous in humans in Western and North-western provinces. The signs and symptoms for cutaneous human anthrax cases were redness and oedema of the skin, oedema of the face, enlarged lymph nodes and fever. Meanwhile the signs and symptoms for gastrointestinal human anthrax cases were vomiting, diarrhoea, abdominal pain and gastroenteritis [20,22].

Hang'ombe et al [24] reported that *B. anthracis* was susceptible to penicillin, chloramphenicol, doxycycline, tetracycline, streptomycin, ciprofloxacin, amoxicillin and gentamicin. It was found to be resistant to vancomycin. Meanwhile, it was intermediate susceptible to cotrimoxazole and erythromycin.

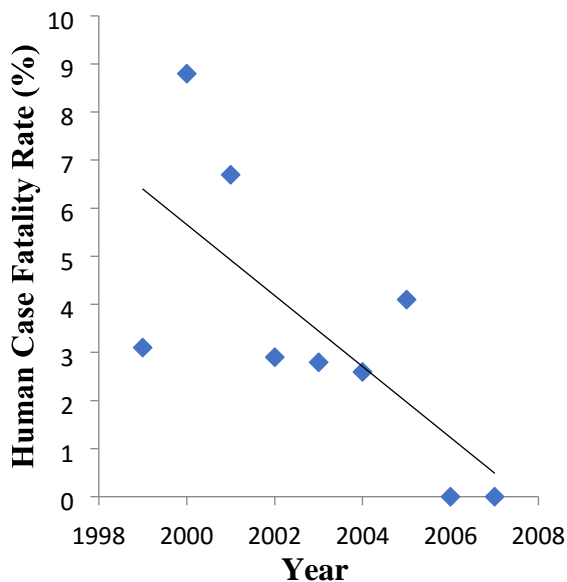


Figure 1 Adapted from Munang'andu et al [22]

Discussion

Little has been published on both human and bovine anthrax in Zambia despite the frequent outbreaks and epidemics reported in the country. Control of anthrax outbreaks and epidemic can only be effective if guided by results of

research on the subject. Whilst control of anthrax in cattle through vaccination has a history of success in Zambia, it is practically impossible to control anthrax in game. WHO [6] estimates that for a single carcass, there are 10 cutaneous and enteric human cases in Africa. This high ratio may partly be attributed to hunger where people have to eat animals that died from anthrax [26,27]. Globally, WHO [8] estimates that there is one human cutaneous anthrax case to ten anthrax livestock carcasses. Although anthrax is a notifiable disease in Zambia, the observed numbers of human cases of anthrax in Western and North-western provinces are an underestimate partly due to inadequate disease surveillance and poor record keeping [28].

Cases of human anthrax cases maybe underreported because of fear of game rangers to suspect them to be poachers. The other reason for underreporting of human cases maybe due to some nonspecific signs and symptoms of anthrax that may go unnoticed as cases of anthrax. Alternatively, a timely and successful response to an outbreak would result in fewer infected humans in relation to infected cattle. This would partly reflect a

good cattle vaccination programme against anthrax. Further, community's acceptance of avoiding coming into contact with an infected animal by skinning, butchering or eating meat of such an animal would reduce human infection rate.

The change in the direction of the cattle:human anthrax ratio between 1991-1993 and 1999-2007 partly reflects changes in the control of the epidemic.

A reduction in the human case fatality rate indicates good case management. An active surveillance of human cases of anthrax is recommended immediately there is an outbreak of anthrax in bovine so that people can start treatment as soon as possible in order to avoid severe cases of human anthrax. Although the common forms of human anthrax in Zambia are cutaneous and gastrointestinal, there are rare cases of inhalation anthrax. People may be infected through the processing of hides and making of mats, drums or stools [23]. The most appropriate antibiotics to use to treat anthrax in Zambia include penicillin, chloramphenicol, doxycycline, tetracycline, streptomycin, ciprofloxacin, amoxicillin and gentamicin. Although WHO [6] recommends use of vancomycin as a supplementary antibiotic in severe cases, it was found to be resistant to *B. anthracis* in

Zambia [25]. Susceptibility tests are recommended to be conducted from time to time to monitor antibiotic resistance to *B. anthracis*.

Conclusion

Anthrax is endemic in Zambia but literature is scanty. There is need for more research to inform policy. A reduction in the human case fatality rate indicates good case management. An active surveillance of human cases of anthrax is recommended immediately there is an outbreak of bovine anthrax in order for people to start treatment early and avoid severe forms of anthrax.

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