Social Science & Medicine 129 (2015) 44–50

Contents lists available at ScienceDirect

Social Science & Medicine

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

A One Health, participatory epidemiology assessment of anthrax (*Bacillus anthracis*) management in Western Uganda

Jeanne L. Coffin [a, *, 1], Fred Monje [b], Grace Asiimwe-Karimu [b], Hellen Janetrix Amuguni [a], Terence Odoch [b]

[a] *Tufts University, USA*
[b] *Makerere University, Uganda*

ARTICLE INFO

Article history:
Available online 17 July 2014

Keywords:
Uganda
Queen Elizabeth National Park
Participatory epidemiology
One Health
Anthrax
Conservation medicine
Disease management
Zoonosis(es)

ABSTRACT

Sporadic anthrax outbreaks have occurred in and around Uganda's Queen Elizabeth National Park (QENP) for years, affecting wildlife, domestic animals, and humans. Reported outbreaks (2004–2005 and 2010) in QENP collectively killed over 500 wild animals and over 400 domestic animals. A 2011 outbreak in Sheema district temporarily froze local markets while killing two humans and seven bovines. One Health is multidisciplinary at its core, yet studies sometimes focus on the effects of animals on human health to the detriment of investigating the surrounding ecological and cultural contexts. Participatory methods connect problems – such as disease – to their context. A multidisciplinary team used participatory epidemiology and conventional structured questionnaires to investigate the impacts of anthrax on human livelihoods and the related perceptions of conservation, public health, and veterinary health efforts in the QENP area. Proximities to previous anthrax outbreaks and to QENP were treated as risk factors in the collection and evaluation of data. Participants' feedback indicates that anthrax prevalence may be greater than officially reported. Community member perceptions about anthrax and other diseases appear to be more closely related to their proximity to QENP than their proximity to anthrax outbreaks. Neither risk factor had a strong effect on knowledge of disease, nor any effect on behaviors associated with disease response or control. Instead, participants reported that social pressures, the economics of poverty, and the lack of health and veterinary infrastructure highly influenced responses to disease. The complex connections between the social needs and the economic context of these communities seem to be undermining current anthrax control and education measures. This livelihood-based decision-making may be unlikely to respond to educational intervention alone. This study provides a strong base for further research and for improvements in effective disease control.

1. Introduction

Anthrax (*Bacillus anthracis*) is an ancient and virulent zoonotic disease with a poorly understood natural ecology (Schuch and Fischetti, 2009). A vaccine to control anthrax was first developed by Pasteur in 1881 and has been updated (Sterne, 1939). Throughout the early 1900s, vaccination campaigns combined with rigorous movement controls lead to successful widespread disease control (FAO, 2014). As a result, natural anthrax has mostly receded from public attention. However, it is still naturally present worldwide and problematic in many countries and regions (FAO, 2014). Anthrax is caused by *B. anthracis*, which is a member of the genus *Bacillus* and part of the *Bacillus cereus* group. Like many species in the *B. cerus* group, *B. anthracis* is a soil bacteria capable of sporulation. This sporulation is an important factor in the complex ecology of *B. anthracis* (Mock and Fouet, 2011). Its ecology involves many factors including the influence of flood–drought cycles, soil qualities (Ness, 1971; Hampson et al., 2011), other soil flora and fauna (Schuch and Fischetti, 2009; Dey et al., 2012), and transport by insects (Hugh-Jones and Blackburn, 2009). The interaction of these factors leads to long dormant periods between outbreaks. Even in regions of endemicity, several decades may pass between outbreaks (Ness, 1971). Therefore, it is difficult to predict when and where outbreaks will occur. Effective control of anthrax as established by the World Organization for Animal Health (OIE) depends

* Corresponding author. Department of Environmental and Population Health, Conservation Medicine, Tufts Cummings School of Veterinary Medicine, 200 Westboro Road, North Grafton, MA 01536, USA.
E-mail address: jeannielois@gmail.com (J.L. Coffin).
[1] Present address: 112 Broad Street, Apt. 1, Asheville, NC 28801, USA.

http://dx.doi.org/10.1016/j.socscimed.2014.07.037
0277-9536/

on cooperation between stakeholders for prophylactic vaccination, vigilance for possible cases, and if necessary, implementation of outbreak control measures (Turnbull, 2002, 2012).

Most commonly, herbivorous mammal infection occurs through the ingestion or inhalation of spores contaminating soil or forage. The disease progresses rapidly as spores transform into vegetative cells and multiply, leading to septicemia and death (FAO, 2014). Clinical signs in herbivorous mammals include sudden death, blood oozing from bodily orifices, and occasional lack of rigor mortis (Dragon et al., 1999). *B. anthracis* sporulation is triggered by contact with oxygen, which is facilitated by decomposition and/or scavenging activity. Unlike the fragile vegetative bacilli, anthrax spores are capable of resisting hostile conditions (Turnbull and Baron, 1996). Recent studies have indicated that *B. anthracis*, previously thought to remain dormant in soils until entering a mammal, may have other methods of replication. It may replicate as a saprophyte in plants (Saile and Koehler, 2006), symbiotically with soil worms via bacteriophages (Schuch and Fischetti, 2009), or within soil inhabiting amoebas (Dey et al., 2012). These studies help explain how soils remain infective for long periods of time.

Human infection occurs through several different routes. Inhalation infection can occur during butchering or curing processes. Infection can also occur through ingestion of contaminated meat. Cutaneous infection can occur during butchering or via insect transport through open wounds (FAO, 2014; USDA-APHIS, 2006). Inhalation and gastrointestinal anthrax are difficult to diagnose early and progress rapidly to septicemia and death. Cutaneous infection can also be fatal, but is more easily diagnosed (Mock and Fouet, 2011). Treatment with antibiotics is effective if diagnosis is timely.

The disease itself and the standard control methods have serious economic, biosecurity, and conservation implications. Recently there have been several outbreaks among wildlife in Uganda's Queen Elizabeth National Park (QENP). The 2004–2005 QENP outbreak killed 499 animals: mostly hippopotami, ungulates, and elephants (Wafula et al., 2008). Anthrax was evaluated and designated an “endemic population regulator” for hippopotamus populations in QENP (Wafula et al., 2008). Such a cycle of disease recurrence results in higher infection risk among towns and villages near the park (Hugh-Jones and de Vos, 2002). However, the most recent outbreak in Uganda was in 2011 in Sheema District (more than 50 km from the park) and involved no wild animals. This outbreak temporarily shut down meat, dairy, and livestock markets and claimed the lives of two humans and nine livestock (Promed-mail, 2011; Bagonza et al., 2011).

Anthrax is a reportable disease in Uganda. Surveillance is led by the Ministry of Health, the Ministry of Agriculture, and the Uganda Wildlife Authority and involves other stakeholders including non-governmental organizations, businesspersons, farmers, and politicians. Several disease control methods in accordance with OIE guidelines (OIE, 2012) for anthrax have been reported sporadically to the OIE, including notifiable disease status, general surveillance, movement control within country, targeted wildlife surveillance, border control, and routine vaccination (OIE-WAHID, 2013). However, the regularity of outbreaks within wildlife and concurrent irregularity of outbreak reports in domestic livestock could indicate underreporting of anthrax in Western Uganda. Underreporting could significantly, if unintentionally, impact the control of a real public health threat.

One Health (OH) is the concept that animal health, human health, and ecosystem viability are intricately linked. Too often studies using OH focus on the effects of animals on human health without thoroughly investigating the surrounding ecological and cultural contexts. This study used community knowledge to investigate the context of possible underreporting of anthrax outbreaks and factors surrounding anthrax presence. The potential underreporting of anthrax concerns agriculture, trade, and security; this merits investigation. The team assessed the level of anthrax in study areas, drew out the underlying factors of disease occurrence and related behaviors of study participants, and probed participants' understanding and knowledge of anthrax and other zoonotic diseases.

2. Methods

2.1. Study design

This study was designed using OH as a framework to leverage interdisciplinary collaboration and knowledge, and selected research methodologies from multiple disciplines. The team included two students from Makerere University's African Field Epidemiology Network (AFENET) fellowship and one student from Tufts Masters in Conservation Medicine program. This team collaborated under supervision of faculty from both universities, as well as staff at the Uganda Wildlife Authority and the International Livestock Research Institute (ILRI). Students and advisors collectively had expertise from veterinary medicine, public health, ecology, wildlife management, and qualitative methodologies.

Two main methodologies were used. Firstly, veterinarians trained in epidemiology and public health conducted conventional public health survey methods. Secondly, appropriate participatory methodologies were chosen from social science. The participatory approach recognizes the importance of local knowledge and buy-in to project success and research veracity. It aims to include all stakeholders in the process of problem-solving, development, research, conservation, or disease management (Mariner and Paskin, 2000; Catley, 1999; Chambers, 1994a, b). Participatory epidemiology (PE), in particular, is used in the evaluation and design of disease management (Catley et al., 2012). The multiple levels of stakeholders from health, trade, and conservation anthrax affects imply that engaging affected communities may be particularly important to disease management. The highest level in the typology of participation (Pretty, 1994) shows participants initiating and maintaining project coordination; however, other levels of participation may be also appropriate. This study aimed for a level 4 or 5 out of 7 in the typology.

2.2. Study site selection

Kasese and Sheema districts were chosen based on proximity to past outbreaks and to QENP. The location of cases in the 2004–2005 QENP outbreak and the center of the 2011 Sheema outbreak were selected as pertinent “anthrax events.” Anthrax events were defined as an officially reported recent case or outbreak. Kasese is 370 km from Kampala on the western edge of Uganda. Sheema is 300 km from Kampala, and is 100 km south east of Kasese center. Within districts, purposive (risk-based) sampling was used to select subcounties where “near” was <10 km and “far” was >10 km to event or park boundaries. The binary categories of “near” and “far” were chosen based on the assumption that individual livestock, wildlife, and persons mostly stay “close to home” in this region. This is largely true, as livelihoods don't involve nomadism and high population density discourages long distance wildlife movement outside of QENP. Different spatial categories would be necessary in areas where these were untrue.

Two villages were chosen purposively from two subcounties (Fig. 1: village locations). Each village contributed one or two focus groups (5–15 individuals), observations from one day, and 8–15 questionnaires to the study. In Sheema district, 29 questionnaires were completed at a farmers' workshop with individuals from