NATIONAL STRATEGY FOR THE PREVENTION AND CONTROL OF ANTHRAX IN HUMANS AND ANIMALS IN KENYA

(2021-2036)

HARAMBEE

REPUBLIC OF KENYA
ZDU ZOONOTIC DISEASE UNIT

NATIONAL STRATEGY FOR THE PREVENTION AND CONTROL OF ANTHRAX IN HUMANS AND ANIMALS IN KENYA

(2021-2036)

Ministry of Agriculture, Livestock, Fisheries and Co-operatives
and
Ministry of Health

February 2022

 This publication was made possible by the generous contribution of the American people through USAID support to FAO. The contents of this document are the sole responsibility of the government of Kenya and does not necessarily reflect the views of USAID or the United States Government

Suggested citation: Zoonotic Disease Unit: National Strategy for the prevention and control of Anthrax in humans and animals in Kenya (2021-2036), Nairobi: Ministry of Agriculture, Livestock, Fisheries and Cooperatives, Ministry of Health; 2021.

REPUBLIC OF KENYA
ZDU ZOONOTIC DISEASE UNIT

Published by: The Zoonotic Disease Unit
P.O. Box 20811- 00202,
Nairobi, Kenya

Cover photo: @FAO/Luis Tato

List of Abbreviations

AU-IBR	African Union Interafrican Bureau for Animal Resources
AHSP	Animal Health Service Providers
BSL	Biosafety Level
CBO	Community Based Organisation
CDC	Centers for Disease Control and Prevention-Kenya
CDVS	County Director of Veterinary Services
CEC	County Executive Commitee
COHUs	County One Health Units
CSF	Cerebral Spinal fluid
CVL	Central Veterinary Laboratory
CZC	County Zoonotic Committee
DG	Director General
DHIS	District Health Information System
DVS	Director of Veterinary Services
EOC	Emergency Operation Centre
FAO	Food Agriculture Organization
FBO	Faith Based Organization
FELTP	Field Epidemiology and Laboratory Training Program
FMD	Foot and Mouth Disease
IDSR	Integrated Disease Surveillance and Response
IGAD	Intergovernmental Authority on Development
IHR	International health regulation.
ILRI	International Livestock Research Institute
IM	Intramuscular
ISAVET	In service Applied Veterinary Epidemiology Training
IV	Intravenous
JEE	Joint External Evaluation
KABS	Kenya Animal Bio surveillance System
KALRO	Kenya Agricultural and Livestock Research Organisation
KEMRI	Kenya Medical Research Institute.
KEVEVAPI	Kenya Veterinary Vaccine Production Institute
KLWSS	Kenya Livestock and Wildlife Syndromic Surveillance
KVA	Kenya Veterinary Association
KWS	Kenya Wildlife Service
MALF	Ministry of Agriculture, Livestock And Fisheries
MOH	Ministry of Health
NAPCC	National Anthrax Prevention And Control Committee
NAPHS	National Action Plan for Health Security
ND1	Notifiable Disease form 1
NGO	Non-Governmental Organization
OHCEA	One Health Central and Eastern Africa
OH	One Health
OIE	World Organization for Animal Health
PCP	Progressive Control Pathway
PCR	Polymerase Chain Reaction
PEP	Post Exposure Prophylaxis
PHEOC	Public Health Emergency Operations Center
PVS	Performance of Veterinary Services
RVILs	Regional Veterinary Investigation Laboratories
SCVO	Sub County Veterinary Officer
SCZC	Sub County Zoonotic Committee
SOPs	Standard Operation Procedures
UHC	Universal Health Care
USAID	United States Agency for International Development
VBM	Valuable Biological Materials
VEES	Veterinary Epidemiology and Economics Section
WHO	World Health Organization
WSU	Washington State University
ZDU	Zoonotic Disease Unit
ZTWG	Zoonotic Technical Working Group

Table of Contents

List of Abbreviations		**i**
Table of Contents		**ii**
List of Figures		**iii**
List of Tables		**iv**
Foreword		**v**
Acknowledgements		**vi**
Executive Summary		**vii**
Chapter One		**1**
1.1	Introduction	1
1.2	Vision	1
1.3	Mission	1
1.4	Rationale and Justification of the Strategy	2
Chapter Two		**3**
2.1.	Aetiology of Anthrax	3
2.2	Drivers of disease spread	3
2.3	Anthrax in animals	3
2.4	Pathogenesis of *B. anthracis* in animals	4
2.5	Clinical manifestation	4
2.6	Diagnosis	4
2.7	Prevention and control of Anthrax in animals.	4
2.8	Anthrax in humans	5
2.9	Socio-economic impacts of Anthrax	7
Chapter Three		**8**
3.1	Anthrax in Kenya- Situation Analysis	8
3.2	Anthrax Surveillance Systems in Kenya	9
3.3	Case definitions – Livestock	9
3.3.1	Suspect case definition	9
3.3.2	Probable case definition	9
3.3.3	Confirmed case definition	9
3.4	Case definitions in humans	10
3.4.1	Suspect case definition	10
3.4.2	Confirmed case	10
3.5	Anthrax Surveillance Systems in Animals	10
3.5.1	Passive surveillance and active surveillance	10
3.5.2	Laboratory surveillance in Kenya	10
3.5.3	Reporting system in Livestock sector	10
3.6	Surveillance System in Wildlife	11
3.7	Anthrax Surveillance System in Humans	12
3.7.1	Passive Surveillance in the health sector	12
3.7.2	Reporting and information system in Public health	12
3.7.3	Laboratory Surveillance in MOH	13
3.7.4	The role of national and county governments in Anthrax disease surveillance	13
3.8	Inter-Sectoral Coordination	13
3.9	Current Anthrax Prevention and Control Activities In Kenya	13

3.9.1 Prevention and control of Anthrax in animals 13
3.9.3 Prevention and control of Anthrax in humans 15
3.10 Policy, Legal And Institutional Framework Supporting Prevention And Control Of Anthrax 15
3.11 Stakeholders Mapping For Anthrax Prevention And Control 16
3.12 Analysis Of Strengths, Weakness, Opportunities And Threats (Swot) 17

Chapter Four **20**
4.0 The Strategic Framework 20
4.1 Guiding Principles of the Strategy 20
4.2 Goal 20
4.3 Main Objective 20
4.4 Anthrax prevention and control strategy Pillars 20

Chapter Five **23**
5.1.1 Phase 1: Preparatory and adoption phase 2021-2023 24
5.1.2 Phase 2: Prioritized implementation in high-risk zones, 2024-2027 28
5.1.3 Phase 3: Implementation of Anthrax prevention and control strategy in high and low-risk areas, 2028-2032 28
5.1.4 Phase 4: Elimination of Anthrax in Humans, 2033-2036 29

Chapter Six: **30**
6.1 Monitoring and Evaluation 30

List Of Contributors **37**
References **38**

List of Figures

Figure 1: Ecological cycle of infection for Anthrax 4
Figure 2: Trend of livestock Anthrax outbreak reports in Kenya, 1957-2017 8
Figure 3: Temporal distribution of Anthrax outbreaks in Kenyan wildlife, 1999-2017 9
Figure 4: Reporting system in the livestock sector (Source; DVS) 11
Figure 5: Wildlife reporting system in Kenya 11
Figure 6: Passive surveillance in the Ministry of Health 12
Figure 7: Implementation of the Anthrax elimination strategy, 2021-2036 23
Figure 8: Schematic diagram showing coordination structure of the Anthrax prevention and control strategy. 25
Figure 9: Spatial distribution of livestock Anthrax outbreaks by counties in Kenya, 1957 to 2017 (Gachohi *et al* 2018) 26

List of Tables

Table 1:	Diagnosis of Anthrax in humans	6
Table 2:	Role of National level and county health authorities in anthrax surveillance	13
Table 3:	Stakeholders for Anthrax prevention and Control	16
Table 4:	Strengths, Weakness, Opportunities and Threats (SWOT) regarding Anthrax Prevention and Control (SWOT Analysis)	17
Table 5:	Anthrax prevention and control work-plan	30

Foreword

This document describes Kenya's National Strategy for Prevention and Control of Anthrax. Anthrax is a bacterial zoonosis of global health security and public health importance that primarily affects herbivores and is characterized by sudden deaths of susceptible animals. Humans often get infected through exposure and contact with infected animals or products such as meat, animal hides, bones and other materials. Anthrax can easily be prevented and controlled through sustained livestock vaccinations, proper disposal of infected livestock carcasses, enhanced surveillance and community awareness of the disease. Prevention and control of the disease in livestock is, therefore, the key to protecting humans and livelihoods.

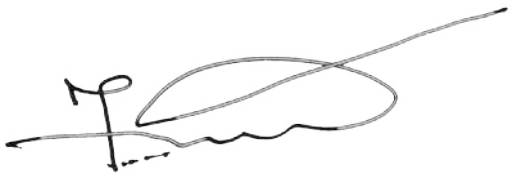
Anthrax is distributed globally and remains enzootic in many regions of the world, particularly sub-Saharan Africa, Asia, Central and South America. The overall global disease burden and economic impact of anthrax in livestock is not fully known. However, epizootics occur every year, resulting in the deaths of hundreds to thousands of animals, and disease transmission to human with approximately 2000 to 20000 human anthrax cases annually worldwide.

In Kenya, Anthrax is the highest ranked zoonotic disease, based on a systematic analysis of burden, socioeconomic impact, epidemic potential, and severity of zoonotic diseases. According to national public health and veterinary records, an average of 10 Anthrax outbreaks involving animals with spill- over to humans occur every year. Anthrax is also a priority disease in Kenya's National Action Plan for Health Security (NAPHS). In addition, the Joint External Evaluation (JEE) conducted in 2017 and Performance of Veterinary Services (PVS) conducted in 2019, jointly recommend developing and implementing an anthrax prevention and control strategy.

Anthrax disease burden and economic impact in Kenya are often underestimated because of suboptimal surveillance systems in public health, livestock and wildlife sectors. Eliminating Anthrax from the livestock population and reduced incidence in wildlife is key to stopping human cases. Reduced Anthrax incidence and eventual elimination of the disease has been demonstrated in developed countries through livestock vaccinations and improved sanitary measures. Therefore, implementation of the anthrax prevention and control strategies in Kenya will further reduce livestock deaths, reduce human suffering and improve food security in line with the Big Four agenda.

This National Anthrax Prevention and Control strategy will guide the country towards systematically reducing the disease risk through sustained livestock vaccinations, enhanced surveillance, proper carcass disposal and public education. The strategy is based on activities planned for the country to move from an endemic state to a disease elimination status by 2036. Successful implementation of this strategy requires a multi-sectoral collaborative approach with the involvement and support of many stakeholders. We are optimistic that each of our partners will join hands and play their role in the prevention and control of Anthrax in Kenya.

Hon. Peter Munya, EGH
Cabinet Secretary
Ministry of Agriculture, Livestock, Fisheries and Co-operatives



Sen. Mutahi Kagwe, EGH
Cabinet Secretary
Ministry of Health

Acknowledgements

This strategy was developed through a consultative process involving key stakeholders and experts on Anthrax prevention and control. The development of the strategy is a great achievement for Kenya, as it provides a systematic approach to reduce Anthrax in livestock, wildlife and with an ultimate goal of eliminating the disease in humans. The development of this strategy is in line with the priorities outlined in Kenya's National Action Plan for Health Security (NAPHS). These priorities were derived from Joint External Evaluation (JEE) conducted in 2017 and Performance of Veterinary Services (PVS) conducted in 2019.

The development process was coordinated by the Zoonotic Technical Working Group (ZTWG), which draws membership from the Ministry of Agriculture, Livestock, Fisheries and Cooperatives, the Ministry of Health, the Kenya Wildlife Service and partner organizations. The ZTWG coordinated the process with support and leadership from the Director of Veterinary Services and Director General for Health. The Zoonotic Disease Unit (ZDU), a collaborative unit between the MOH and MALF, led the drafting process.

The development of the strategy was made possible through generous support from Food and Agriculture Organization (FAO) -Global Health Security Agenda (GHSA) project, financed by the United States Agency for International Development (USAID). We highly appreciate this support. We specifically acknowledge the institutions listed below whose representatives participated in the development of this strategy. A complete list of contributors has been included in Annex 1

- Council of Governors
- County Governments
- Food and Agriculture Organization
- United States Agency for International Development
- Centers for Disease Control and Prevention
- Field Epidemiology and Laboratory Training Program
- International Livestock Research Institute
- Kenya Medical Research Institute
- Kenya Society for the Protection & Care of Animals
- Kenya Veterinary Association
- Kenya Veterinary Vaccines Production Institute
- Kenya Wildlife Service
- Neglected Tropical Diseases Programme
- World Animal Protection
- Washington State University
- University of Liverpool- HORN project
- University of Nairobi
- Zoonotic Diseases Unit

Mr. Harry Kimtai, CBS
Principal Secretary
State Department of Livestock
Ministry of Agriculture, Livestock, Fisheries
and Co-operatives

Susan Mochache, CBS
Principal Secretary
Ministry of Health

Executive Summary

Anthrax is a zoonotic disease caused by *Bacillus anthracis*, a spore-forming bacteria naturally found in soil and affects all warm-blooded animals, particularly herbivores. Humans are secondarily infected through contact with infected animals or contaminated animal products, or direct exposure to *B. anthracis* spores. Animals get infected through inhalation or by direct consumption of spores during grazing, while carnivores are infected by consuming the affected herbivores. Anthrax can also intentionally be used as a bio-warfare or bioterrorism agent because of its ease of manipulation in laboratory set-up and release into the environment.

The disease is enzootic in several regions of Africa, Asia, European countries and countries/areas of north and South America. Livestock vaccinations and improved hygienic practices have reduced incidences in most developed countries. In Kenya, the disease is endemic in most parts of the country, especially in Nakuru, Murang'a, Kiambu, Narok and Meru Counties, where livestock, humans and wildlife are often affected. According to national medical and veterinary records, Kenya reports at least ten outbreaks each year involving animals and humans.

Anthrax in animals presents in various forms; peracute, acute, subacute, and rarely, chronic. Commonly, herbivores are found dead without prior clinical signs due to rapid septicemia. Before death, herbivores may show classic signs of high fever, oozing of non- clotting blood from natural orifices and incomplete rigor mortis. Pigs and other scavenger animals like dogs who feed on infected carcasses are relatively resistant to anthrax, and the disease often presents as inflammation of the oral cavity with mild gastrointestinal manifestations.

In humans, Anthrax causes three main clinical forms: cutaneous, gastrointestinal and inhalation. Cutaneous anthrax is the most common, accounting for more than 95%, but it usually causes a milder disease. Gastrointestinal anthrax causes mild or moderate to severe disease upon ingestion of raw or undercooked and contaminated meat. Inhalational Anthrax is rapidly fatal upon inhaling spores aerosolized during processing or contact with contaminated hides, bones, hair or wool.

Anthrax in livestock can be controlled through; isolation/separation of affected animals from the herd, treatment of affected animals and provision of prophylaxis for susceptible animals. Further spread can be controlled by proper disposal of carcasses through incineration or deep burial, decontamination of surfaces/equipment, vaccination of susceptible herds and quarantine in outbreak areas.

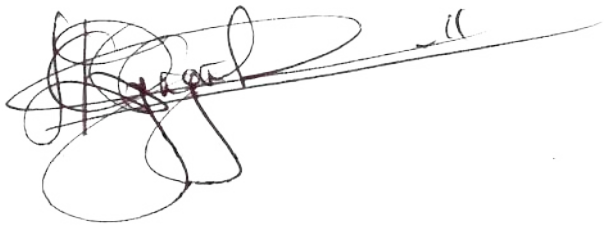
Human cases are easily treated with a wide range of antibiotics, given orally or intravenously. Mild to moderate forms require oral antibiotics for 3-7 days, while severe inhalational and gastrointestinal infections require hospitalization and parenteral treatments. Severe cases recover fully with effective and timely treatment.

Early detection and response to Anthrax outbreaks is key to preventing further spread of the disease in livestock and spill-over to humans. An effective surveillance system ensures early detection of disease incidences, confirmatory diagnosis and prompt reporting to responsible authorities, ensuring an effective and timely response.

This national strategy for the prevention and control of Anthrax guides the country to systematically reduce the disease in livestock, wildlife and humans. Its development involved multiple stakeholders and subject matter experts. The general outline of the strategy emulates the global strategies for the elimination of Foot and Mouth Disease (FMD), Rinderpest and Rabies. Implementation of the strategy will be supported by specific guidelines which will be developed in the first phase of implementation.

The strategy has eight specific objectives:

1. To enhance coordination, collaboration and partnership structures for anthrax prevention and control
2. To strengthen the prevention and control of anthrax in animals and humans
3. To strengthen surveillance, reporting systems and outbreak response
4. To enhance laboratory diagnostic capacity of anthrax across the country
5. To promote risk communication among stakeholders on anthrax
6. To advocate for operational research on anthrax
7. To promote biosafety and biosecurity measures at all levels
8. To facilitate resource mobilization for the implementation of the strategy



Dr. Obadiah N. Njagi, PhD, OGW
Director of Veterinary Services
State Department of Livestock
Ministry of Agriculture, Livestock, Fisheries and Co-operatives

Dr. Patrick Amoth, EBS
Ag. Director General for Health
Ministry of Health


©FAO/Luis Tato

Chapter One

1.1 Introduction

Anthrax is a zoonotic disease caused by *Bacillus anthracis*, a gram-positive, rod-shaped, spore-forming bacterium, naturally found in the soil[1]. The disease affects all warm-blooded animals, primarily domestic and wild herbivores, and it is transmitted through ingestion of bacterial spores from soil or vegetation[1,2]. Humans are secondarily infected through contact with infected animals or contaminated animal products or direct exposure to *B. anthracis* spores[2]. Other routes of infection include ingestion of contaminated animal products and inhalation of anthrax spores. Anthrax outbreaks are often detected late in livestock and wildlife through fatalities or spillover to humans. As a result, the natural prevalence of anthrax infection in animal populations is largely unknown [1,3,4]. Humans can also be infected through the deliberate release of weaponized *B. anthracis* spores as an act of bioterrorism or biological warfare hence *B. anthracis* is classified as a class A highly infectious agent by the United States Centers for Disease Control and Prevention (CDC)[5].

Anthrax causes significant public health and economic impacts. The World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO) classify Anthrax as a transboundary disease based on its negative impact on food security, nutrition, livestock production and trade[6]. Anthrax causes hundreds to thousands of animal deaths, and 2000 to 20000 human anthrax cases annually worldwide [7]

The disease is enzootic in several regions of Africa, Asia, European countries and countries of North and South America [2,7]. Anthrax occurs sporadically in most developed countries but incidence varies with implementation of national control and prevention strategies. The geographical distribution of anthrax is associated with specific ecological factors that promote the viability and survival of *B. anthracis* spores [7, 8]. There is proof of concept that the disease can be eliminated through an integrated approach as is the case in many developed countries [2] .

Anthrax is the highest ranked priority zoonotic disease in Kenya, based on a systematic analysis of burden, socioeconomic impact, epidemic potential, and severity of zoonotic diseases[11]. The disease was also prioritized in the National Action Plan for Health Security (NAPHS) derived during the Joint External Evaluation (JEE) in 2017 and Performance of Veterinary Services (PVS) conducted in 2019. Despite the significant burden of anthrax in the country, prevention and control efforts are often inadequate and uncoordinated resulting in recurrent outbreaks and production losses.

This strategy is based on guidelines from the OIE Terrestrial Animal Health Code, the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals and WHO anthrax in humans and animals - 4th edition, existing zoonotic disease strategies and published data.

1.2 Vision

Anthrax free Kenya

1.3 Mission

To progressively reduce and eliminate animal and human Anthrax in Kenya through sustained surveillance, proper disposal of carcasses and contaminated materials, animal vaccination, treatment in humans and creating community awareness through the One Health approach.

1.4 Rationale and Justification of the Strategy

Kenya has a vibrant livestock sector estimated to contribute about 12% of the gross domestic product (GDP)[17]. Animal diseases such as Anthrax are endemic, reducing reducing the growth potential of the sector. In addition, Kenya is renowned for its rich wildlife biodiversity and wildlife-based tourism is a major foreign exchange earner, second after agriculture. However, Anthrax is a threat to wildlife populations in many national parks and conservancies. Anthrax outbreaks hamper tourism resulting in reduced (GDP) and unexpected local decline in abundance of endangered animals. In the health sector, Anthrax cases are often misdiagnosed and this can result in preventable deaths. if untreated, anthrax is estimated to cause 5-20% of deaths among human cutaneous cases and 90-100% in the inhalation form. if cases are untreated. It is estimated that, Anthrax causes 5-20% deaths among cutaneous human cases and 90%-100% in the inhalation form. Health and Veterinary records show more than 10 anthrax outbreaks occur annually with the involvement of humans [3]. This is still considered an under estimate of the true burden due to the passive nature of the surveillance system.

The devolution system of governance in Kenya and separate devolvement of livestock and public health disease control strategies has resulted in uncoordinated disease prevention and control efforts, with many cases of livestock and human diseases going either unreported or detected very late. The lack of One health strategy for anthrax prevention and control has further contributed to the increase in Anthrax cases in livestock, wildlife and humans. This was also acknowledged in the OIE led Performance of Veterinary Services (PVS) (2011 & 2018) and in the WHO Joint External Evaluation (JEE) of 2017.

The development of the Anthrax prevention and control strategy will guide the country on how to progressively reduce the burden of the disease in humans and livestock, and improve livestock, wildlife, and human health in affected areas.

Chapter Two

2.1. Aetiology of Anthrax

Bacillus anthracis is a bacterium that occurs in two forms; vegetative form and spore form.
The vegetative form: This is a fragile form that is easily inactivated by disinfectants, moderate temperatures and normal postmortem changes. This form is usually found within the host.

Spore form: Large quantities of the *B. anthracis* are shed when an Anthrax infected animal dies, and once the bacteria are exposed to the air, sporulation starts, forming resistant spores contaminating the environment. Anthrax spores are resistant to heat, cold, pH changes, desiccation, chemicals, irradiation and other adverse conditions and can survive for years in soil, wool, and hair of infected animals [2]. This becomes the source of infection for other susceptible hosts through inhalation, ingestion and cuts in the skin. The spores germinate to produce the vegetative forms that multiply, eventually killing the host and releasing spores in new areas, promoting the Anthrax cycle.

2.2 Drivers of Disease Spread

The rate and extent of sporulation by vegetative cells shed from infected animals is affected in a complex manner by the environmental conditions into which they fall. Temperature, humidity, water activity (available water within the microenvironment), pH, oxygen availability, sunlight among others are all influencing factors [8]. In addition, climate probably acts directly by influencing the way in which the animal comes into contact with the spores: for example, grazing closer to the soil in dry periods when grass is short, or moving animals to restricted or or new areas in search for water and pasture or by indirectly affecting the immune status of the host and thereby affecting the level of resistance to infection [9].

Effects of seasons, rainfall, temperature, soil, vegetation, condition of the animal and population density on the epidemiology of anthrax have been hypothesized [13, 14]. This is normally based on concepts of conditions under which *B. anthracis* may germinate and multiply in the environment. The varying observations on the association between the factors mentioned above and anthrax incidence and persistence in a specific locality can be explained further by research[12].

2.3 Anthrax in Animals

Anthrax is primarily a disease of herbivores but it can also affect other species such as pigs, horses, dogs, cats and other vertebrates. Cattle, goat and sheep are highly susceptible and can have hyper-acute to acute disease, including sudden death without prior signs of illness. Pigs and carnivores may show subclinical signs as they are more resistant.[10]. The incubation period in livestock is typically 3 to 7 days (range 1 to 14 days)[2]. However, subclinical Anthrax infection has been reported in wildlife herbivores based on naturally occurring antibodies [10].

2.3.1. Transmission

The source of infection is mainly a *Bacillus anthracis* spore in the environment. Animals become infected through ingestion of the spores when grazing or browsing from contaminated soil, plants, or water and re-starting the cycle since *B. anthracis* is non-invasive[12]. Inhalation of spores during grazing is also responsible for spread of infection[2](Figure 1) . Biting flies serve as mechanical vectors after feeding on infected carcasses and contaminating vegetation and appear to play an essential role in explosive outbreaks [2, 10]. Carnivores and pigs acquire infection through ingestion of meat or food waste from Anthrax infected carcasses. Trade in animal products (meat, hides, hair,wool,bones and feedstuffs) may risk the spread of the disease if contaminated[2].

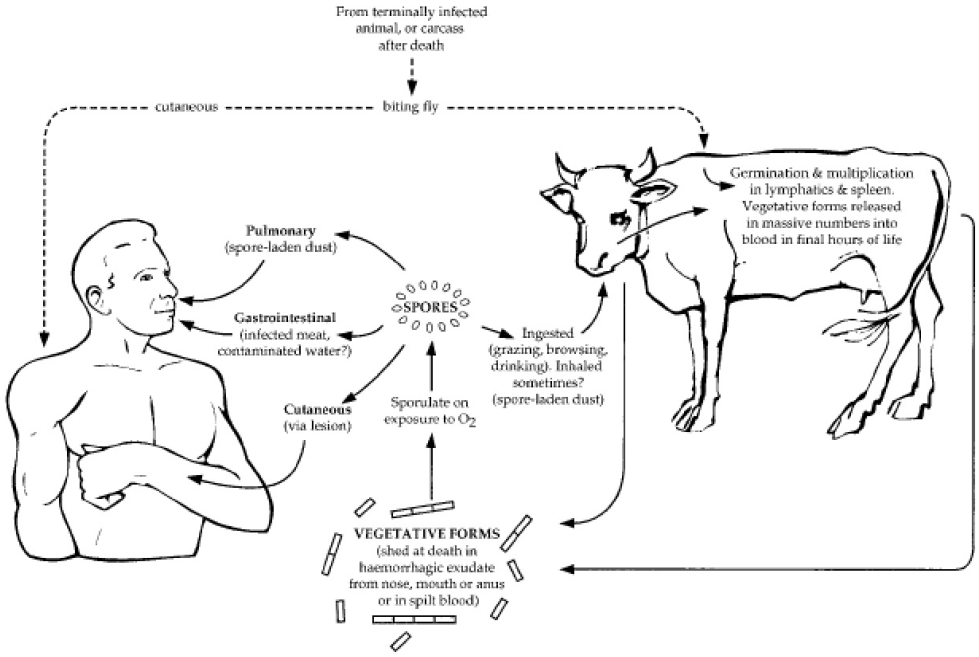


Figure 1: Ecological cycle of infection for Anthrax

2.4 Pathogenesis of *B. anthracis* in Animals

When Anthrax spores enter the body, they get carried to the lymphatics, which they multiply and are released into the blood stream. The toxin produced in the blood stream destroys the endothelial cell lining of the blood vessels resulting in internal bleeding and oozing of non-clotting blood from the natural orifices (ears, nostril, mouth, anus, and vagina).

2.5 Clinical Manifestation

Clinical manifestation varies among species reflecting the difference in susceptibility. In more susceptible animals such as herbivores, the disease presents as sudden death without any signs, and this could be accompanied by bloody discharges (dark tarry) from natural orifices, bloating and failure of blood to clot and incomplete rigor-mortis. In subacute conditions, signs include apnea and edematous swellings around the neck, flanks or lumbar region and difficulty in breathing. Death usually occurs in 2–3 days if no treatment is given. The main symptoms in carnivores and primates are local edema and swelling of the face, neck, and pharyngeal region. However, subclinical Anthrax infection has been reported in wildlife herbivores based on naturally occurring antibodies[10].

2.6 Diagnosis

2.6.1 Clinical Diagnosis

In non-vaccinated herbivores anthrax is usually a peracute disease characterized by sudden death, frequently with bleeding from orifices and subcutaneous haemorrhages.

2.6.2 Laboratory Diagnosis

B. anthracis is classified as a level 3 pathogen (may cause serious or potentially lethal disease through inhalation) and its laboratory confirmation should be done using appropriate biocontainment equipment and trained personnel. Anthrax is diagnosed by examining blood (or other tissues) for the presence of the bacteria *B. anthracis* using;

1. Microscopy (gram staining)
2. Ascoli test (test for antigen using rabbit antiserum)
3. Culture and isolation
4. Immunohistochemical analysis
5. Polymerase Chain Reaction (PCR)

Samples must be collected and packaged to avoid to avoid contamination of the environment and prevent human exposure to the bacteria.

2.6.3 Differential Diagnosis in Animals

Anthrax must be differentiated from other conditions that cause sudden death; these are

1. In bovine and ovine: Clostridial infections, Trypanosoma vivax, lightning strike, acute leptospirosis, bacillary hemoglobinuria, anaplasmosis, acute poisonings by bracken fern, sweet clover, and heavy metal poisoning e.g. lead
2. In equines: acute infectious anaemia, purpura, colic, lead poisoning, lightning strike, and sunstroke.
3. In swine: African swine fever and malignant pharyngeal oedema..
4. In canines: acute systemic infections and pharyngeal swellings due to other causes.

2.7 Prevention and Control of Anthrax in Animals

The standard control of Anthrax involves breaking the cycle of infection.[2] In summary, the farmer should notify the local veterinary authority or registered veterinary officer in cases of sudden deaths. The veterinary officers should urgently confirm the outbreak (clinically or laboratory diagnosis). Upon confirmation;

1. Inform respective veterinary and public health authorities (One health approach)
2. All sick animals should be isolated and treated with effective antibiotics (if this is recommended).
3. Carcasses should not be opened and should be disposed off and all contaminated grounds and materials disinfected and decontaminated as per the guidelines.
4. Movement restriction of livestock and animal by-products from infected farms..
5. Ring vaccination of the rest of the herd and surrounding herds (radius of 1-15 km- based on the production system from the index case).
6. Annual vaccination for three consecutive years after an outbreak to break the infection cycle in an area should be recommended.
7. Public education to emphasise on farmers to regularly inspect their animals, report illnesses or sudden deaths to authorities, and adhere to movement controls and dangers of handling infected animals. In addition, joint communication between the public health and veterinary teams will be helpful to allay fears in the community.
8. Conduct an epidemiological investigation to promptly identify the source of infection and to map out the extent of the outbreak.
9. Intensify surveillance and monitoring in areas surrounding the infected premises for early detection of additional cases.
10. In wildlife, controlling an outbreak primarily focuses on preventing transmission from dead animals: burning, covering, or burying carcasses to prevent access by scavengers, adopting fly control measures, restricting access to suspected contaminated areas or water sources, and when practical, safely disposing of animal carcasses and disinfection and disposal of contaminated materials. Vaccination campaigns effectively control anthrax outbreaks in livestock; however, control strategies for outbreaks in wildlife populations are limited. Vaccination in wildlife focuses primarily on endangered species.

2.8 Anthrax in Humans

2.8.1 Transmission

Humans can get Anthrax infection by handling animal products from infected animals without protective gear or by inhaling anthrax spores from contaminated animal products. Anthrax can also be spread by eating undercooked meat from infected animals. The incubation period from 1 day to more than two months. Direct human to human transmission is possible but very rare, mainly through the cutaneous form[2]. In addition, human infections can be due to inhalation of spores as a result of bioterrorism acts and biological warfare [16] .

2.8.2 Forms of Anthrax in Human

Three main forms of human Anthrax manifest depending on the route of transmission and are classified into; cutaneous, gastrointestinal and inhalation Anthrax. All forms can lead to systemic disease and death if untreated.

Cutaneous Anthrax: This is the most common form globally accounting for more than 95% of all Anthrax cases and normally causing milder disease[2,3]. The bacterium (usually as spores) enters through a skin lesion (cuts, abrasion and rarely insect bites), during handling of an infected carcass, contaminated wool, hides, leather or hair products of infected animals. The incubation period ranges from 9 hours to 3 weeks, mostly 2-7 days. Skin infection begins as an initial itching at the affected sites (within 1-2 days) that develops into a papule, vesicle and then to a depressed black eschar (a characteristic black necrotic area in the center). The ulcer is painless and without pus unless there is secondary infection. Exposed sites like the head, neck, forearm, hand and legs are commonly affected.

Gastrointestinal (ingestion) Anthrax: This form results from consuming of meat or blood contaminated with *B. anthracis*. This can present as oropharyngeal or intestinal Anthrax. The oropharyngeal form is characterized by fever, sore throat, painful swallowing and regional swollen lymph and death is usually due to toxaemia. The intestinal form is characterized by acute inflammation of the intestinal tract with signs like fever, nausea, vomiting, abdominal pain, loss of appetite, vomiting of blood, and severe (bloody) diarrhea. This form results in deaths in up to 60% of cases without treatment.

Inhalational Anthrax: This is a rapidly fatal form of Anthrax and humans develop the disease through inhalation of spores aerosolized during processing or contact with contaminated hides, bones, hair or wool. Deliberate release of anthrax spores (bio-aggression/bioterrorism) also leads to the rapidly fatal inhalational anthrax [2,3]. The average incubation period is about 4 days ranging from 1-7 days although incubation period of up to 60 days has been reported [2]. Initial symptoms are mild and non-specific but quickly progress to severe breathing problems, shock, disorientation with coma, and death.

2.8.3 Diagnosis of Human Anthrax

A history of exposure to contaminated animal materials, occupational exposure and living in an endemic area is important when considering a diagnosis of Anthrax. Diagnosis in humans can be made through the clinical manifestation of a painless, pruritic papule, surrounding vesicles and oedema, with no pus usually on an exposed part of the body. Clinical diagnosis is confirmed by demonstrating of Gram-positive encapsulated bacilli from the lesion and/or positive culture for *B. anthracis* from the lesion following history of exposure (Table 1).

Table 1: Diagnosis of Anthrax in humans

Clinical Picture	Clinical diagnosis	Sample type	Laboratory diagnosis
Cutaneous Anthrax	Clinical history and symptoms	Aspirate from the lesion, biopsy	Gram stain, culture or PCR
Inhalational/ pulmonary Anthrax/ oropharyngeal	Clinical history & symptoms, Chest X- ray,	Sputum, tracheal aspirate, lung biopsy, blood , oropharyngeal aspirate	Culture & Gram Stain/ Smear, PCR, ELISA
Gastrointestinal Anthrax	Clinical history & symptoms	Stool, blood	Culture , PCR
Meningeal Anthrax	Clinical history & symptoms	CSF, blood	Gram stain, Culture and PCR

2.8.4 Differential Diagnosis

The differential diagnosis of cutaneous anthrax includes: boil (early lesion), arachnid bites, ulcers (mainly tropical); erysipelas, glanders, plague, syphilitic chancre, ulceroglandular ttularaemia, clostridial infection, rat-bite fever, leishmaniasis, or herpes. Generally these other diseases and conditions lack the characteristic oedema of Anthrax [2].

2.8.5 Treatment, Prevention and Control of Anthrax in Humans

Anthrax prevention and control in human hinges on;

- Prompt identification and treatment of infected persons- Treatment is given for 3-7 days and drugs of choice is penicillin given orally for mild to moderate cases.
- For severe or potentially life threatening cases, treatment is given parenterally, in hospital settings for 10—14 days. Supportive care should be provided depending on the condition of the patient including analgesics, antipyretics and anti-inflammatory drugs. In very severe cases, assisted respiration, fluid and electrolyte supplements, cerebral oedema management or other measures may be taken.
- Where penicillin is contraindicated, alternative choices include aminoglycosides, macrolides, quinolones and tetracycline.
- In fatal cases, postmortem examinations should be discouraged; cremation is preferable to burial where local custom permits. The body should be placed in an impervious body bag for transport, then placed in a sealed coffin and buried without reopening.
- Public education to create awareness in the community, with emphasis on dangers of handling infected animals and feeding on dead animals. Joint communication between the public health and veterinary teams will be helpful to allay fears in the community
- Human Anthrax vaccines are available (not in Kenya) but are reserved for at-risk occupations e.g. Military personnel, scientists working with Anthrax, people in other high-risk professions.
- For the general public, control of the disease should be done through control in livestock.

2.9 Socio-economic Impacts of Anthrax

Globally, it is estimated 2000 to 20 000 human anthrax cases are occurring each year [3,9]. Epizootics also occur in animals resulting in hundreds to thousands of animal deaths and disease transmission to human[13]. Estimates shows that 1.83 billion people live within regions of anthrax risk. More importantly, a total of 63.8 million poor livestock keepers and 1.1 billion livestock live within vulnerable regions[15].

In Anthrax-endemic areas, livelihoods are impacted negatively through herd deaths, milk withholding in affected dairy herds, complete condemnation of carcass/by-products closure of abattoirs, treatment of the sick and vaccination cost of the survivors [14]. Placement of quarantine shocks livestock markets and may lead to non-compliance and further transmission[15].The slaughtering of Anthrax infected carcasses for consumption and sale may increase exposure and infection of humans.

The government incurs losses due to loss of productivity of the sick or dead. A surge in medical care may require setting up temporary care sites and free treatment to to the affected. Again, there is cost of destruction of carcasses, decontamination of the affected areas and reduced government revenue due to livestock market closure[15]. Loss of consumer confidence negatively affects businesses, leading to low meat consumption, which in-turn decreases the number of cattle slaughtered [16].

Outbreaks among wildlife can have devastating effects on wildlife conservation, resulting in a significant reduction or complete loss of endangered animal species while fear among the public may stop them from visiting parks resulting in revenue loss [3,11].

Chapter Three

3.1 Anthrax in Kenya- Situation Analysis

Anthrax has been documented in livestock for the past 60 years in Kenya. Data from the Directorate of Veterinary Services (DVS) spanning from 1957 to 2017 show a total of 666 livestock anthrax outbreaks reported across the country. Counties with the highest number of reported outbreaks were; Kiambu with 191 outbreaks, Meru, Narok and Nyeri, reported between 50-60 outbreaks each, while Murang'a, Nakuru and Nairobi reported 25-40 outbreaks each (Figure 2).

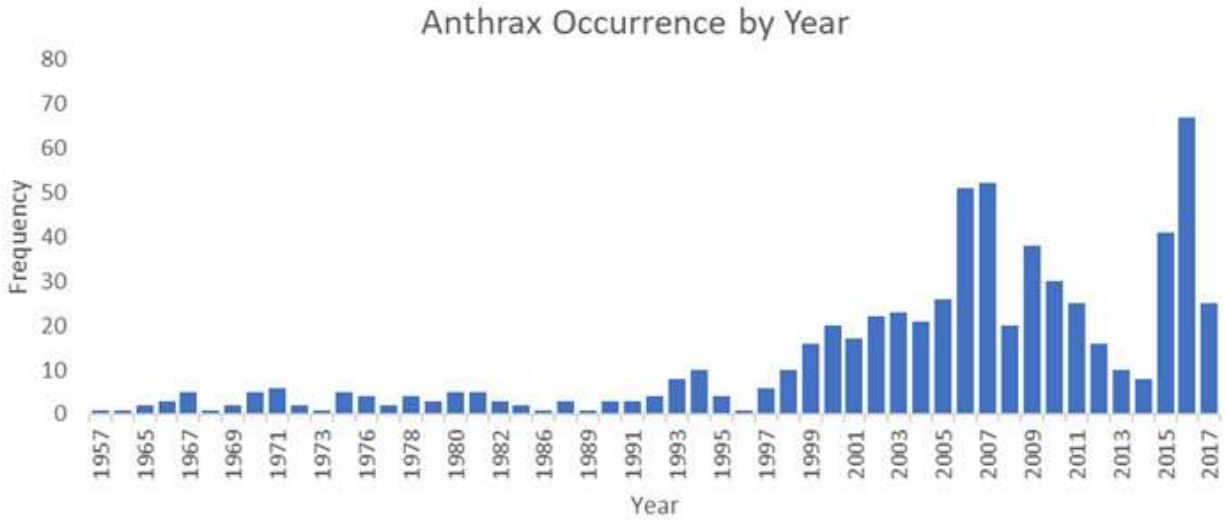


Figure 2: Trend of livestock Anthrax outbreak reports in Kenya, 1957-2017 (Source; Nderitu *et al.*, 2021)

Anthrax was more frequently reported in cattle than other animals, a trend that was maintained across all the 60 years. More than ten outbreaks were reported annually throughout the country since 1999 except in 2013 and 2014 (Figure 2), with more than 50 outbreaks occurring in 2006, 2007 and 2016. Outbreaks were evenly distributed across the years, reported during both the wet and dry seasons.

According to the Kenya wildlife service (KWS) records between 1999 and 2017, a total of 51 Anthrax outbreaks were documented, causing 1014 Anthrax deaths across 22 wildlife conservation areas in Kenya, affecting 24 different wildlife species (Figure 3). Generally, herbivores were the most (90%) affected species and they included, Buffaloes, black rhinos and elephants. Like in livestock, Anthrax outbreaks were reported in both dry and wet seasons, but more than two-thirds of the outbreaks occurred during the seven months of dry seasons.

Outbreaks involving endangered wildlife species have been documented in the Samburu wildlife ecosystem, where 53 Grevy zebra and 26 plain zebra's Anthrax deaths were reported in 2005/2006. In 2011, 12 Rothschild's giraffe died in Mwea National park while in 2015, Nakuru National park reported mortality of 687 animals of different species among which 97% (669) were buffalos and 0.7% (5) black rhinoceros.

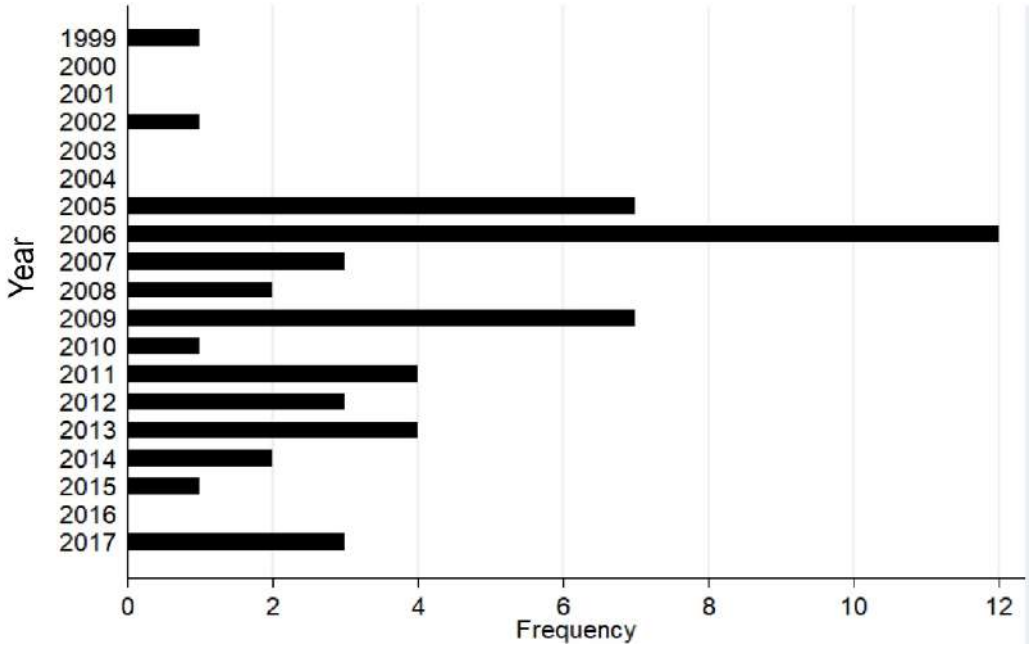


Figure 3: Temporal distribution of Anthrax outbreaks in Kenyan wildlife, 1999-2017 (Source: Gachohi *et al.,* 2019)

In most cases, Anthrax outbreaks are detected when humans are affected. A review of 15 Anthrax outbreak investigations between 2005 and 2018 showed that 12 (80%) spilled-over to humans with a total of 155 human cases. Of these 127 (82%) were cutaneous, 19 (12.5%) intestinal form and 1(0.6%) inhalational form) with a case fatality of 5.2%. These outbreaks occurred in Nakuru, Kiambu, Murang'a, Samburu, Kirinyaga, Turkana, Vihiga and Bomet Counties. Data from the passive surveillance system in the Ministry of Health, District Health Information System (DHIS2) reported 276 and 79 Anthrax cases in 2017 and 2018 respectively.

3.2 Anthrax Surveillance Systems in Kenya

Anthrax is a notifiable disease in both animal and human health surveillance systems. Anthrax cases definitions (A set of standard criteria for classifying whether a person/animal has a particular disease) are provided for the disease in both livestock and humans reporting systems.

3.3 Case definitions – Livestock

These are according to FAO Anthrax case classifications[20]

3.3.1 Suspect Case Definition

A suspected case is a case that is compatible with the clinical description. For example, in endemic areas all sudden deaths should be regarded as suspected anthrax cases.

3.3.2 Probable Case Definition

A suspected case with dark tarry un-clotted blood on postmortem.

3.3.2 Confirmed Case Definition

A suspected case of Anthrax accompanied by demonstration of gram-positive rod-shaped *B. anthracis* or growth of the bacteria on a blood agar plate

3.4 Case Definitions in Humans

These case definitions are adapted from the WHO Anthrax case classification

3.4.1 Suspect Case Definition

A suspected case of Anthrax in a human may be defined as:

- A clinically-compatible case of illness without isolation of *B. anthracis* and no alternative diagnosis, but with laboratory evidence of *B. anthracis* by one supportive laboratory test; or
- A clinically-compatible case of Anthrax epidemiologically linked to a confirmed environmental exposure (infected animal product, contaminated fomite, or other sources)

3.4.2 Confirmed Case

A confirmed case of Anthrax in a human can be defined as a clinically compatible case of cutaneous, inhalational or gastrointestinal illness that is laboratory-confirmed by:

- Isolation of *B. anthracis* from an affected tissue or site; or
- Other laboratory evidence of *B. anthracis* infection based on at least two supportive laboratory tests.

Note: It may not be possible to demonstrate *B. anthracis* in clinical specimens if the patient has been treated with antimicrobial agents.

3.5 Anthrax Surveillance Systems in Animals

3.5.1 Passive Surveillance and Active Surveillance

Passive surveillance is the routine reporting of the cases of diseases reaching veterinary practitioners for treatment or service. Early warning systems rely on passive surveillance where data has already been collected for some other purpose. Several tools are available for disease reporting; -Notifiable Disease Reporting forms (ND1)/ Sanitary report forms, Zero report form and Kenya Livestock and Wildlife Syndromic Surveillance (KLWSS)/Kenya Animal Bio Surveillance System (KABS). In active surveillance detailed disease search/investigations are planned following suspected cases of Anthrax.

3.5.2 Laboratory Surveillance in Kenya

The country has six regional veterinary investigation laboratories (RVILs) namely; Kericho, Eldoret, Garissa, Karatina, Nakuru and Mariakani, two satellite laboratories (Ukunda and Witu) and the Central Veterinary Laboratory (CVL) at Kabete, Nairobi. The Faculty of veterinary medicine Laboratories, University of Nairobi, also receives and tests suspect Anthrax samples. Anthrax outbreaks are often confirmed through blood smears in laboratories. Monthly laboratory surveillance reports are submitted to the Veterinary Epidemiology and Economics Unit (VEES) at the Directorate of Veterinary Services (DVS). However, confirmatory diagnostic capacity with molecular techniques (PCR) or through culture using gamma phage is not yet established in the RVILs due to lack of biosafety and biosecurity infrastructure.

3.5.3 Reporting System in Livestock Sector

Reporting of diseases in the livestock sector is done from the lowest level (Ward) to the National Level (DVS) as outlined in Figure 4. A standard form (ND1 form) is used to collect epidemiological data on the suspected animal cases and submitted to the DVS through the County Director of Veterinary Services (CDVS). A standard form (LB1 form) is also filled when samples are collected and submitted to the regional or Central Veterinary Laboratory (CVL) for confirmation.

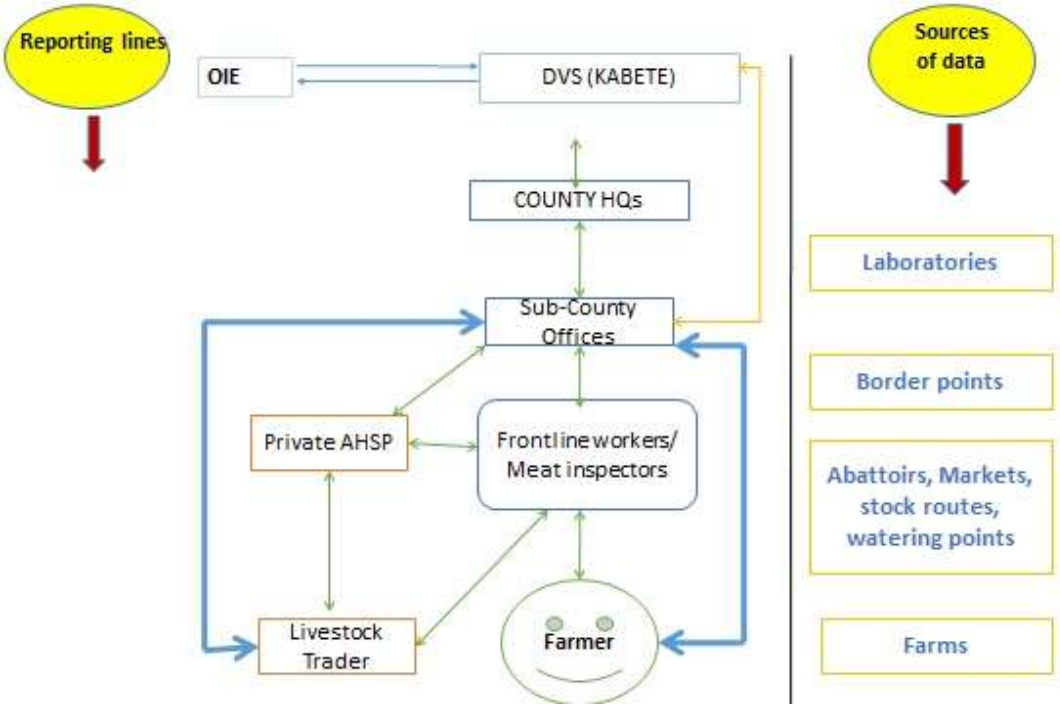


Figure 4: Reporting system in the Livestock Sector (Source; DVS)

3.6 Surveillance System in Wildlife

Kenya Wildlife Services has a Veterinary and Capture Services Department that provides veterinary services to wildlife in protected and dispersal areas nationally. It also monitors any outbreaks and makes appropriate recommendations. In addition, the department investigates the source of disease outbreaks and institute appropriate control measures. The department executes its mandate from its headquarters in Nairobi and eight satellite mobile veterinary units located in areas with a high concentration of wildlife where veterinary services are required most. A network of KWS scientists, wardens and rangers across the country assist in reporting suspicious cases to the department. For confirmation, samples collected from suspected anthrax cases are normally submitted to regional veterinary laboratories (VILs) or central veterinary laboratories (CVL). The KLWSS/KABS system has provided near real-time notification of wildlife diseases since 2016.

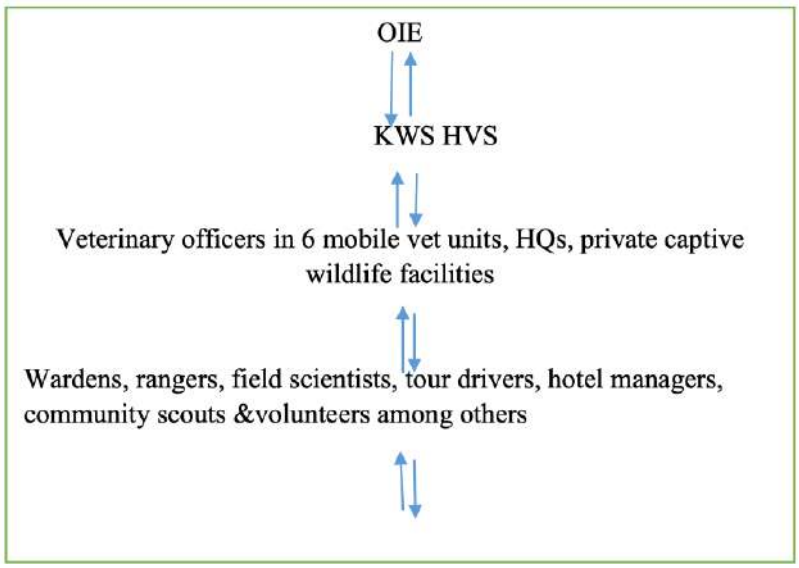


Figure5: Wildlife diseases reporting system in Kenya.

3.7 Anthrax Surveillance System in Humans

3.7.1 Passive Surveillance in the Health Sector

Kenya implements its disease surveillance through the Integrated Disease Surveillance and Response (IDSR) strategy (regional strategy for strengthening national disease surveillance systems in the African region). Anthrax is among 36 diseases prioritized for reporting through the IDSR indicator-based surveillance system. One confirmed case of Anthrax constitutes an outbreak in that locality. Anthrax cases and deaths are reported weekly in the IDSR system, however data on clinical information like the forms of anthrax is not collected.

3.7.2 Reporting and Information system in Public health

Information is collected at the health facilities level and transmitted to the Sub-county level using standardized paper-based tools. The system then transits at this level into a web-based electronic-IDSR platform for onward transmission to county and national levels. All the data collected and transmitted through the IDSR system is stored in the District Health Information System (DHIS2), the national web-based reporting system.

The MOH established the Public Health Emergency Operations Center (PHEOC) in 2016 to enhance coordination of information and resources for managing public health emergencies including infectious diseases emergencies. The PHEOC often detects anthrax outbreaks through its elaborate network of information sources.

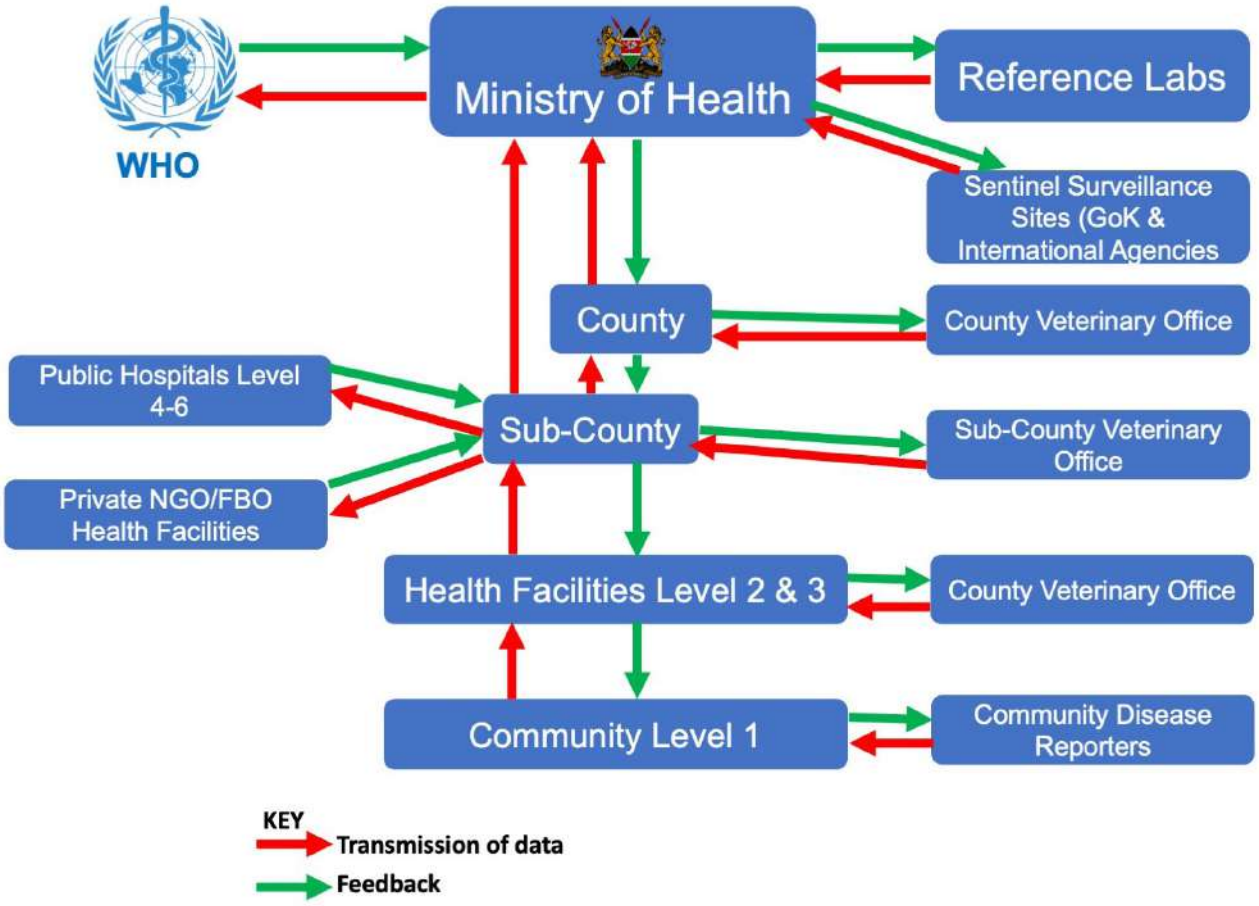


Figure 6: Passive surveillance in the Ministry of Health

3.7.3 Laboratory Surveillance in MOH

Kenya has a National Public Health Laboratory Services system that operates under the Ministry of Health. The laboratory system, just like the health facilities, is structured into four tiers: from primary to tertiary level (specialized labs). The main reference laboratories are based in Nairobi but there is an established network of health facility laboratories and research laboratories. Sample referral guidelines exists, and anthrax samples are also referred for confirmation as hazardous materials. .

3.7.4 The Role of National and County Governments in Anthrax Disease Surveillance

National and County govenrments play an important role in protecting, preserving and promoting the health and safety of the public. These two levels of government work with synergy and their roles are described in the table below.

Table 2: Role of National level and county health authorities in anthrax surveillance

National authorities	County/sub county authorities
• Analyses and provide feedback data back to county and sub-county • Report to international bodies e.g. (WHO, OIE) • Formulate policies &guidelines, and allocate resources based on surveillance information • Provide technical support (laboratory services, epidemiologist, capacity building, educational materials) • Coordinates control and prevention activities • Support and coordinate disease control	• Detect and report suspected anthrax cases to National authorities and stakeholders • Support and coordinate disease control at the County level • Diagnose and investigate anthrax outbreaks • Analyze received data and provide feedback to the county officers • Initiation of control and prevention measures • Implement policies

3.8 Inter-Sectoral Co-ordination

In 2011, Kenya established a One Health referred to as the Zoonotic Disease Unit (ZDU), to establish and maintain active collaboration at the animal, human and ecosystem interface towards better prevention and control of zoonotic diseases. Therefore, the role of ZDU is to coordinate various government and non-government agencies and partners involved in zoonotic diseases prevention and control.

The ZDU strengthens coordinated surveillance through routine joint risk assessment, surveillance and notification between the veterinary and human health sectors during zoonotic disease events, leads the development of guidelines for prevention and control of zoonotic diseases, and maintains databases zoonotic diseases. In addition, pilot County One Health Units (COHUs) were established to enhance collaboration between the human and livestock sectors. However, these COHUs need to be strengthened and more to be established for each County.

3.9 Current Anthrax Prevention and Control Activities in Kenya

Kenya has lacked a clear and explicit national strategy, adequate institutional and legal framework for anthrax prevention and control, leading to fragmentation of efforts by different actors, with weak linkages and cross reporting.

3.9.1 Prevention and Control of Anthrax in Animals

Anthrax control in animals is under the mandate of the DVS and various methods have been put in place to control the disease. Normally, routine vaccination should be practised as a preventive measure in counties where the disease is endemic. However, vaccination is often conducted as a reactionary measure to an outbreak. In wildlife, KWS often provide alternative watering points away from the outbreak zone to break the infection cycle. Carcass disposal is mostly though on-site incineration when few animals are involved while burying using heavy-duty machinery is employed in outbreaks affecting many animals. Vaccination via drop-off darts is conducted to protect endangered species. However, the cost of control in wildlife is expensive due to the logistics


©FAO/Luis Tato

3.9.2 Vaccination

In Kenya, the DVS has approved the use of Blanthax® or Bivax® vaccine for active immunization of animals against anthrax and black quarter. It is imported by local pharmaceutical companies who may sell directly to county governments and Kenya Veterinary Vaccines Production Institute (KEVEVAPI). The vaccine is prepared from living spores of an encapsulated avirulent strain of *Bacillus anthracis* in alum precipitated *Clostridium chauvoei*. The vaccine is indicated for use in cattle, horses, camels, sheep and goats.

3.9.3 Prevention and Control of Anthrax in Humans

Public education is usually conducted during outbreaks to communities affected. Suspect cases are often treated with mass administration of penicillin antibiotics since there is no strategy or guidelines for case management. During anthrax outbreaks, the response is coordinated by ZDU.

3.10 Policy, Legal and Institutional Framework Supporting Prevention and Control of Anthrax

The following policies, laws and regulations guide the prevention and control of Anthrax at national, regional and international levels:

i. *International Health Regulations (IHR) (2005) :* Helps countries review and if necessary, strengthen their ability to detect, assess and respond to public health events.
ii. *National Action Plan for Health Security (NAPHS) :* Accelerates the implementation of IHR core capacities in a country and is based on a One Health approach. It captures national priorities for health security, brings sectors together, identifies partners and allocates resources for health security capacity development.
iii. *National Action Plan on Prevention and Containment of Antimicrobial Resistance* (NAPAMR, 2017-2022) : provides a common framework for action and management of AMR by multisectoral stakeholders in Kenya, human and animal health, agriculture, fisheries and environmental sectors
iv. *OIE/FAO/WHO :* provides broad guidance and protocols on disease surveillance, contingency planning, preparedness and response to zoonotic diseases.
v. *World Organization for Animal Health (OIE)* terrestrial animal health code sets standards for the improvement of animal health and welfare and veterinary public health worldwide; OIE manual for diagnostic tests and vaccines for terrestrial animals and OIE Performance of veterinary services
vi. *World Health Organization (WHO)* - in partnership with OIE has developed manuals for brucellosis prevention and control.
vii. *FAO/OIE:* Progressive Control Pathways (PCPs) and the related roadmaps are staged, stepwise approaches increasingly used to structure the road to disease reduction and freedom for a range of human and animal diseases.
viii. *AU-IBAR* - Integrated regional coordination mechanism sets ways and multi-sectoral approaches for prevention and control of zoonoses.
ix. *Intergovernmental Authority on Development (IGAD) :* Provides an animal health framework that enhances domestic food security and increases access to livestock and livestock products to national, regional and international markets.
x. *Vision 2030 - Big four agenda :* Kenya Universal Health Care (UHC) provides access to quality primary health care to address over 80% of a person's health needs throughout the life cycle by focusing on preventive and promotive health interventions.
xi. *Kenya Veterinary Policy* - It provides guidance on control and prevention of zoonotic diseases particularly the use of multi-sectoral collaboration using one Health approach.
xii. *Kenya Health Policy (2014-2030)* - The overall objective is to attain universal coverage of critical services that positively contribute to realising the overall policy goal. Among the objectives are to eliminate communicable diseases and strengthen collaboration with other sectors that have an impact on health.

xiii. *Biosafety and Biosecurity policy and guidelines :* define the scope and applicability of "laboratory biosecurity" recommendations, narrowing them strictly to human, veterinary and agricultural laboratory environments, generally focusing on dangerous pathogens and toxins, addressing the safekeeping of all valuable biological materials (VBM).

xiii. *Animal Diseases Act, Cap 364 :* Provides the legislative framework and power to carry out all necessary disease control actions needed to control notifiable diseases in Kenya.

xiv. *Public Health Act - Cap 242 :* Grants powers to local health authorities to protect the health of members of the public, including compulsory reporting of notifiable infectious diseases.

xv. *Meat Control Act, Cap 356 :* Enables control to be exercised over meat and meat products intended for human consumption.

xvi. *The County Governments Act No.17 of 2012 :* gives the county governments powers to ensure e¨ciency in service delivery and partnership with organizations for work, service or function within the county

xvii. *Veterinary Surgeons and veterinary para-professionals Act, Cap 366 :* Gives Kenya Veterinary Board (KVB) powers to license, certify and discipline veterinary surgeons and veterinary para-professionals.

xviii. *One Health (OH) Strategic Plan :* Its main objective is to strengthen surveillance, prevention and control of zoonoses, establish structures and partnerships to promote OH, and to conduct and promote applied research on zoonoses.

3.11 Stakeholders Mapping for Anthrax Prevention and Control

Anthrax prevention and control requires the support of multi-sectoral and multi-disciplinary stakeholders drawn from government and non-state agencies. Below is a summary of key stakeholders and their roles in Anthrax prevention and control (Table 3).

Table 3: Stakeholders for Anthrax prevention and Control

Thematic Area	Stakeholders
Coordination, Policy, standards and strategy development	MOH, MoALF, Kenya Wildlife Service, Zoonotic Disease Unit, Council of Governors and County Governments
Technical support, capacity building and resource mobilization	WHO, FAO, OIE, Centers for Disease Control(US CDC), Africa CDC, USAID, IGAD, One health central and eastern Africa(OHCEA) AU-IBAR, One Health Horn of Africa (HORN), East African Community (EAC), Technical training institutions and universities.
Enforcement of Laws and regulations	Ministry of Interior, MOH, MoALF, KWS County Governments
Research and Training	Local Institutions: Kenya Medical Research Institute (KeMRI), Kenya Agricultural& Livestock Research organization (KALRO), Local Universities, Human and Animal Health Training Institutes International Institutions: International Livestock Research Institute, Washington State University, US Centers for Disease Control, University of Liverpool among others.
Vaccine Production, importation and distribution	Kenya Veterinary Vaccine Production Institute, Local and international vaccine importers
Biosafety and Biosecurity	MOH, MoALF, Kenya Wildlife Service, Local Universities and colleges, Non-Governmental Organizations (NGOs). Laboratories;- Public Health Laboratories, CVL,RVL, KEMRI, KWS laboratories
Public Awareness of Anthrax and risk communication	MOH, MoALF, KWS, ZDU, Ministry of Interior, Private sectors (e.g. Safaricom) , learning institutions, Community based organizations, Non-governmental organizations, Media, County Governments
Advocacy , Communication and social mobilization	Professional bodies; Kenya Medical Association(KMA), Kenya Veterinary Association(KVA), Kenya Veterinary paraprofessional association, Farmers Organizations and associations, Religious Organizations, Ministry of Interior and Coordination of National Government., Relevant Non- governmental organizations
Implementers of the Strategy	MOH, MoALF, KWS, ZDU, County Governments, NGOs, Community based organisations (CBOs),Faith-Based organization(FBOs), Private Sector actors, Livestock farmers, Research institutes and Universities, Community and all relevant stakeholders.

3.12 Situational Analysis of Strengths, Weakness, Opportunities and Threats (SWOT)

This section outlines the strength and opportunities that could be harnessed to facilitate prevention and control of Anthrax. In addition, weaknesses and threats which must be addressed for effective prevention and control of the disease are highlighted below.

The SWOT followed the following thematic areas;

i. Institutional organization
ii. Resource mobilization
iii. Mechanism for Anthrax surveillance, prevention and control
iv. Research and training development
v. Advocacy, communication and social mobilization
vi. Multi-sectoral collaboration
vii. Biosafety and Biosecurity

Table 4: Strengths, Weakness, Opportunities and Threats (SWOT)

Thematic Area	Strength	Weaknesses	Opportunity	Threat
Institutional organization	• Presence of human and animal health infrastructure and institutions including OH coordination unit (ZDU) • Presence of OH Strategic plan for control and prevention of zoonoses • Skilled human resource at various levels (human, animal and environment) • Anthrax is top priority zoonotic disease and also identified as area of prioritization by Joint External Evaluation (JEE) of internal health regulation (IHR) • Devolved health and veterinary services • Existence of national sectoral policies, strategies and legal frameworks	• Inadequate communication coordination and data sharing between the two line ministries • Few trained technical staff at both national and County level • Lack of harmonized guidelines for anthrax prevention and control	• Presence and support by International organizations (FAO, WHO, OIE etc.) • Presence of K-FELTP and ISAVET, OHCEA and other continuous professional development programs responsible for training of staff • Availability of global guidelines and standards from international bodies like FAO, OIE, WHO, Global Health Security Agenda 2017 and International Health Regulations (IHR) • Technical support from local, regional and international partners	• Inadequate resource allocation to health and livestock services • High turnover of staff • Emerging and re-emerging diseases • Overlapping activities • Lack of legal OH framework

Thematic Area	Strength	Weaknesses	Opportunity	Threat
Resource mobilization (Financial)	• Annual budgetary allocation for disease control including surveillance, outbreak response and coordination by line ministries and County departments	• Allocated funds are inadequate • Lack of mechanisms for sharing resources across the line ministries • Lack of single basket fund for Zoonoses control including anthrax	• Partnerships with development and bilateral partners • National and International attention on OH and Zoonosis • Increase in allocation for devolved functions including public health and veterinary services	• Competition for resources with other priority zoonoses and re-emerging diseases • Other competing political interests
Mechanism for anthrax surveillance, prevention and control	• Availability of high quality vaccine • KEVEVAPI- an institution with expertise for high quality anthrax vaccine production and marketing • Availability of trained surveillance officers to conduct surveillance, outbreak investigation and response • Epidemiology in-service Trainings; Basic, Intermediate and Advanced levels • International and local legal frameworks that support anthrax prevention and control • Reporting channels such as (IDSR) for humans,ND1 forms and KLWSS/KABS for livestock and wildlife • Presence of functioning emergency operating center (EOC) in MoH • Availability of laboratory diagnostic capacity for anthrax (in animals) countrywide	• Inadequate funding allocation to surveillance and prevention efforts • Low vaccination coverage in livestock • Inadequate training of some field officers to properly handle anthrax outbreaks • Low level of awareness of the disease by livestock farmers leading disease spread and spill-over to humans • Underreporting of suspected anthrax cases in human and livestock due to the passive nature of the surveillance • Weak enforcement of legal frameworks that obligates farmers and field officers to report diseases • Lack of indemnity and compensation mechanisms • Unregulated livestock and animal products movement across the country • Lack of diagnostic capacity for human anthrax in some parts of the country • Late reporting of animals cases lead to missed diagnosis • Lack of specific anthrax prevention and control guideline • Absence of a disease emergency operations center in the MoALF	• Subsidy of vaccine costs with increased demand • International (OIE, IHR 2005) and local requirements for reporting of diseases • The Big Four Agenda (2019-2022) that seeks to ensure food security • Presence of reference laboratories that can provide expertise and training in anthrax diagnostics, as well as quality assurance and proficiency testing • The ongoing projects to upgrade animals and human health laboratories at the national level • Establishment of county diagnostic laboratories in the veterinary department	• Re-emergence of anthrax in areas perceived to be low risk • Social-cultural practices • Changing priority of diseases in different counties
Research and training development	• Presence of research and training Institutions (Kenya Universities, KEMRI, CDC, ILRI, WSU, K-FELTP) • Presence of strong research regulatory bodies • Political will by the government by allocating funds to students for research • KFELTP and ISAVET trains epidemiologists on outbreak investigations and other disease control interventions	• Inadequate research that can enhance anthrax control for example, data on the burden of anthrax in the country, economic benefits of anthrax control, anthrax vaccination coverage is lacking • Low documentation of outbreak events and few published papers on anthrax • Trainings programs are largely donor funded	• Increased interest on anthrax as a potential bioterrorism threat results in increased funding • Collaborations with international reference laboratories, and national and international research institutions • Counties increased interest in EPI training	• Changing research priorities • Bioterrorist use of anthrax spores • Sustainability of the donor funded training programs

Thematic Area	Strength	Weaknesses	Opportunity	Threat
Advocacy, communication and social mobilization	• Existence of elaborate administrative infrastructure down from farmer for the both ministry of Health and livestock that can support information sharing. • Good mobile network in most parts of the country • Communication channels and media across the country including vernacular platforms	• High cost to relay messages across most communication channels • Lack of context specific messages • Lack of a communication strategy	• Free spots are available in some media channels	• Challenging social and cultural practices • Social media can put out alarming unauthorized information.
Multi-sectoral collaboration	• Zoonotic technical working group (ZTWG) which is multi-sectoral (MoH, MoALF, WHO, FAO, AU-IBAR, KEMRI, CDC, KWS and others and its chaired by director of veterinary services(DVS) or director general in the MoH • Establishment of county one health unit(COHU) • The revision of the One Health strategic plan for prevention and control of Zoonoses (2021-2025)	• Infrequent meetings and over-delegation • Lack of anthrax specific technical working group/ Taskforce • Lack of formal mechanisms for information exchange between sectors	• Increasing awareness of OH and the need to collaborate between sectors • Available OH networks/ forums/ organizations both regionally and globally e.g. OHCEA • Devolution of public health and veterinary services	• Institutional reorganizations
Biosafety and Biosecurity	• Existence of national reference laboratories, (NPHLs, CVL,) and other Research laboratories (CDC, KEMRI) that provides biosafety and biosecurity to suspected anthrax cases/samples • Biosafety and Biosecurity curriculum	• Inadequate biosafety and biosecurity facilities at field level • Inadequate knowledge on biosecurity and biosafety issues of technical staff and farmers • Lack of guidelines especially at low levels	• Accreditation processes	• Ability to use anthrax as a bioterrorist agent

Chapter Four

4.0 The Strategic Framework

4.1 Guiding Principles of the Strategy

- Anthrax control requires a multi-sectoral and multi-disciplinary collaborative approach.
- Prevention and control of Anthrax in animals effectively reduces negative impact on public health and the national economy.
- Control of Anthrax involves breaking the cycle of infection which can only be achieved through early detection and notification of the disease and instituting proper control measures.
- Community engagement is central in the prevention and control of Anthrax.

4.2 Goal

To eliminate Anthrax in humans and reduce animal cases in Kenya through integrated interventions.

4.3 Main Objective

To eliminate human Anthrax and reduce the incidence in animals to less than 1% of the 2020 baseline by 2036.

4.3.1 Specific Objectives

1. To enhance coordination, collaboration and partnership structures for Anthrax prevention and control
2. To strengthen prevention and control of Anthrax in animals and humans
3. To strengthen surveillance, reporting systems and outbreak response
4. To enhance laboratory diagnostic capacity of Anthrax across the Country
5. To promote risk communication among stakeholders on Anthrax
6. To advocate for operational research and innovation on Anthrax
7. To promote biosafety and biosecurity measures at all levels
8. To facilitate resource mobilization for the implementation of the strategy

4.4 Anthrax Prevention and Control Strategy Pillars

This strategic plan will be deployed to prevent and control Anthrax in humans and animals in Kenya using a combination of the following pillars.

4.4.1 Coordination, Collaboration and Partnership

Partnerships and multi-sectoral collaboration among national and county governments, NGOs, and the private sector will be required to implement the Anthrax prevention and control strategy successfully. The Inter-Governmental Relations Act number 2 of 2012 establishes a framework for consultation and co-operation between the national and county governments and among county governments; to establish mechanisms for resolving of inter-governmental disputes under Articles 6 and 189 of the Constitution and for connected purposes.

Government agencies involved in Anthrax control include; Ministries (health, livestock, education, finance, interior and coordination of national government), regulatory bodies responsible for human and animal health, wildlife service and state law office. Additional support will be required from regional and international partner organizations. All these are important in giving technical and financial support for the planning and implementation of the program.

A National Anthrax Prevention and Control Committee (NAPCC), with representation from the various sectors will be established to coordinate anthrax prevention and control strategy at the national level. In addition, similar coordination committees will be established; County Zoonotic Committee (CZC) at county level and Sub-County Zoonotic Committee (SCZC) at sub-county levels.

4.4.2 Surveillance, Reporting Systems and Outbreak Response

Surveillance is a critical element in the prevention and control of Anthrax. Effective Anthrax surveillance will enhance early detection in animals before spilling over of disease to human. Surveillance generates data to monitor the progress or impact of the prevention and control efforts, essential for sustainable implementation. As control efforts progress towards Anthrax elimination in humans, surveillance becomes even more critical in ascertaining Anthrax elimination status. It will therefore be important to assess and enhance the existing surveillance systems. In addition, mechanisms for reporting and information sharing of anthrax surveillance data between the DVS and Director General (DG) and other relevant stakeholders will be strengthened. Community-based surveillance will be enhanced through community health volunteers (CHVs) and community disease reporters (CDRs). Capacity for field officers on sample collection and referral (packaging, transportation) will be strengthened. Coordinated joint outbreak preparedness and response plan using the one health approach will be developed.

4.5 Prevention and Control of Anthrax

4.5.1 Prevention and control of Anthrax in Animals

Anthrax is primarily controlled through animal vaccination, prompt response to animal outbreaks and public health education.
Anthrax control in animals hinges on;

i. Immediate notification of suspected animal to a veterinary authority/registered practicing veterinary officer and restriction of animal movement.
ii. Prompt sharing and verification of information between the veterinary and public health personnel that results in appropriate, timely prevention and control measures .
iii. Enhance Anthrax vaccine availability (production, safety, quality, efficacy and distribution) and coordinated mass vaccinations of animals in high risk areas.
iv. Improving sanitary measures (carcass disposal, disinfection, avoid contact with infected livestock and livestock products)
v. Community risk communication

4.5.2 Prevention and Control of Anthrax in Humans

The prevention and control of Anthrax in humans depends on limited and appropriate human contact with infected animals and products. This will be achieved through:

i. Enhanced safety regulations in handling suspected and confirmed Anthrax cases.
ii. Prompt identification and treatment of infected people.
iii. Antibiotic prophylaxis for exposed exposed individuals.
iv. Enforcement of food safety regulations, e.g. meat inspection at abattoirs and re-inspection.
v. Enhanced traceability of animals and animal products
vi. Community education and awareness on Anthrax as a disease, prevention and control.

NB: It is important to note that pre or post-exposure vaccination for the general public is not recommended in Kenya. The Anthrax vaccine is currently provided to high-risk populations such as members of the U.S. military and certain laboratory workers.

4.5.3 Anthrax Diagnostic Laboratory Capacity

Laboratory capacity assessment includes identifying existing national, regional, and local laboratories performing Anthrax diagnostics. Various aspects of the laboratories such as the existing workforce, established diagnostic and logistic capacity, available equipment, facility infrastructure and waste management will be evaluated. The report will be used to determine need for appropriate training, facility improvements, and diagnostic algorithms to ensure the safety of all facility staff.

This will be achieved through:

- Mapping and needs assessment of laboratories for both human and animal health
- Strengthening national, regional and county laboratory capacity for Anthrax confirmatory diagnosis
- Establishing/enhancing inter-sectoral, inter-laboratory networking (public and animal health)
- Maintaining anthrax biosafety and biosecurity measures

4.5.4 Conduct and Promote Operational and Applied Research

Operational research will be used to gather evidence to support the implementation of the strategy, document best practices and guide optimal solutions to implementation challenges. The output will ensure the best use of available resources and provide evidence on what is achievable. Priority research areas include;

- Assess the Anthrax disease burden in animals and humans.
- Determine the socio-economic impact of the disease
- Develop and update Anthrax risk map.
- Vaccination coverage and vaccine effectiveness studies.
- Evaluate trends in Anthrax incidence in humans and animals.
- Evaluation of Anthrax elimination interventions.
- Ethno-veterinary practices in regards to Anthrax management.

4.5.5 Risk Communication

Raising awareness on Anthrax prevention and control is essential in preventing exposures in humans. Enhanced awareness also improves anthrax control efforts in animals by increasing reporting of potential animal cases and improving sanitary measures. A risk communication plan will be developed to implement this prevention and control strategy within which target audience(s), media and channels for distribution of messages will be identified. The objective of the communication plan will be:

- To raise public awareness on the risk of Anthrax for communities.
- To empower the community through behavioral change and communication.
- To mobilize resources to support the Anthrax elimination program.
- To improve the knowledge and skill of health and veterinary professionals

4.5.6 Biosafety and Biosecurity

Good biosafety, laboratory biosecurity and biocontainment practices are fundamental to public health. Minimization of biosafety and biosecurity breaches (in field, laboratory, and clinic/hospital) should therefore be at the core of the operation of containment although such environments cannot be entirely free of risks. In the context of biological weapons threats (bioterrorism), biosecurity is the effective implementation measure that aims to prevent terrorists, criminals and spies from gaining access to dangerous pathogens and toxins. Related measures limit access to equipment, technologies and information that could be used for malicious purposes involving biological weapons.
This will be mainly done by:

- Capacity building.
- Situational analysis to identify the critical control points.
- Development of quality improvement plans.
- Linkage with other stakeholders e.g. security agencies.

4.5.7 Resource Mobilization

Implementation of the Anthrax prevention and control strategy requires resources including human resources, infrastructure and finances. A needs assessment will be important to identify areas of spending such as procurement of diagnostics and treatment supplies, capacity building, vaccines, and vaccine logistics, operational research, surveillance, monitoring and evaluation. A funding plan will be developed to ensure that resource needs are identified for every phase. Funds will be sourced from the line government ministries; Ministry of Agriculture, Livestock, Fisheries and cooperatives, Ministry of Health, the County Governments, research institutions as well as local and international partners.

Chapter Five

5.1 Implementation of the Anthrax Elimination Strategy, 2021-2036

The implementation of the strategy will follow four phases (1- 4) with progressive reduction of the disease in animals towards elimination in humans. Each phase has a set of activities that will be synchronized to ensure synergy and leverage. The implementation phases for the Anthrax strategy is summarized in Figure 7 below:

- Phase 1: Development and adoption of strategy and preparation for implementation: 2021-2023
- Phase 2: Prioritized implementation of Anthrax prevention and control strategy in high-risk zones: 2024-2027
- Phase 3: Full-scale implementation of Anthrax prevention and control strategy: 2028-2032
- Phase 4: Elimination of Anthrax in Humans: 2033-2036

Kenya is currently (2021) in phase 1 and a set of targets must be achieved for the country to move from one phase to the next.

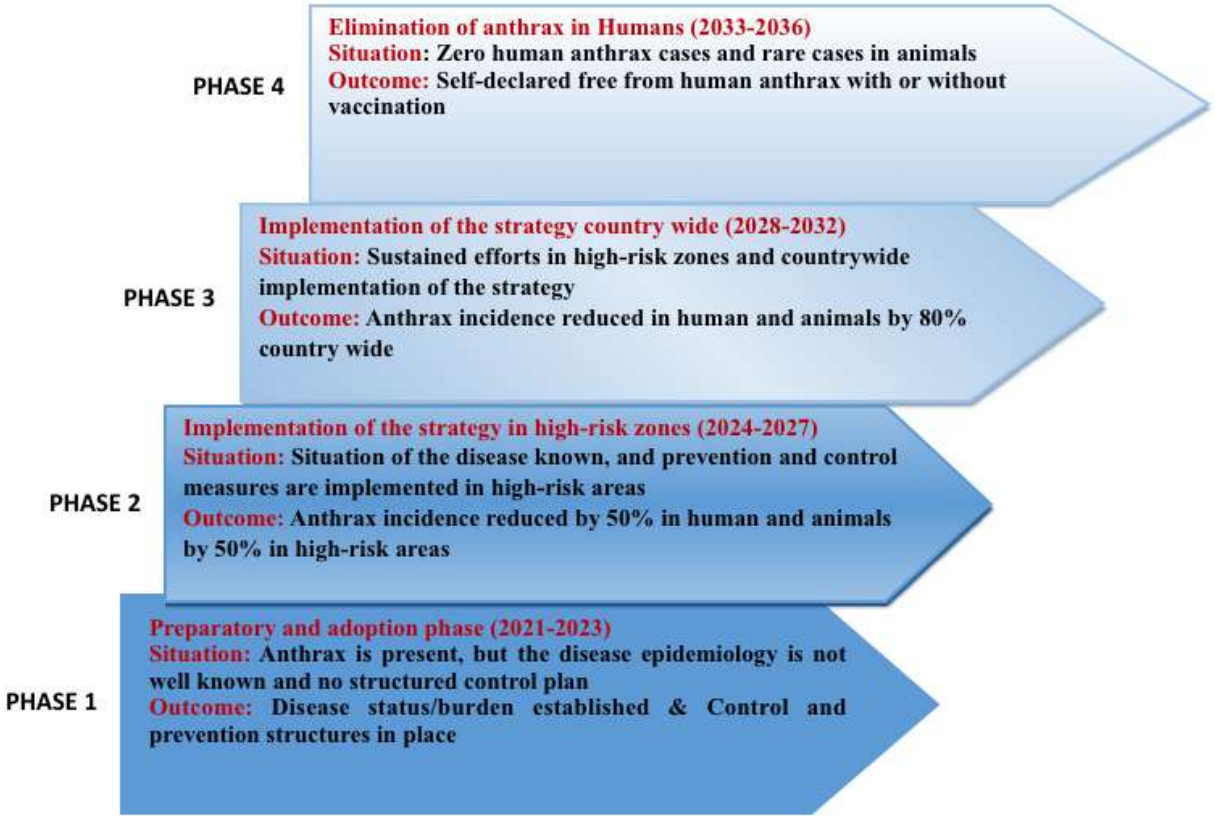


Figure 7: Implementation of the Anthrax elimination strategy, 2021-2036

5.1.1 Phase 1: Preparatory and Adoption Phase 2021-2023

1. Development of guidelines and standard operating procedures (SOPs) to operationalize the strategy

To support implementation of the strategy, several guidelines will be developed to standardize the implementation of activities across the country. These are:

i. Guidelines for Anthrax human case management.
ii. Guideline on Anthrax outbreak investigation.
iii. Guidelines on Anthrax surveillance and information sharing between animal and human health sectors.
iv. Guidelines for safe transportation, handling and disposal of carcasses.
v. Guidelines for anthrax vaccination and treatment in animals.
vi. Guidelines for decontamination, disinfection and waste disposal.
vii. Guidelines for infection prevention and control.
viii. Guidelines for sample management and Anthrax laboratory diagnosis
ix. Communication guidelines.

2. Establishment of National Anthrax Prevention and Control Committee (NAPCC)

To coordinate the implementation of the strategy, a National inter-sectoral taskforce will be established, with representation drawn from various organizations including but not limited to :

i. Ministry of Health
ii. Ministry of Agriculture, Livestock, Fisheries
iii. Kenya Wildlife Service
iv. Ministry of Interior and coordination of National government
v. Ministry of Defense
vi. Council of Governors and Chairs of County Executive Committee (CECs) members in charge of human and animal health
vii. Ministry of Devolution and Planning
viii. Research /Training Institutions/ Non-governmental organization involved in Anthrax prevention and control
ix. Representation from International and Regional organizations e.g. FAO, WHO, OIE, CDC, ACDC, AU-IBAR
x. Human and animal health professional and regulatory bodies
xi. Private practitioners in animal health and medical diagnostic laboratories

As illustrated in (Figure 8), the NAPCC will be a technical sub-committee of the Zoonotic Technical Working Group (ZTWG) and ZDU will be the secretariat. Roles of the NAPCC are :

i. Overall responsibility for implementing the Anthrax prevention and control strategy
ii. Provide technical guidance to county coordination structures
iii. Resource mobilization
iv. Provide periodic updates the public
v. Monitoring and evaluation
vi. Provide technical advice to ZTWG and periodic updates to the public and stakeholders
vii. Propose changes and amendments of regulation and laws on Anthrax
viii. Inter-county and international cross border engagements

3. Establishment of County Zoonotic Committee (CZC)

The CZC will be formed at the county level to coordinate activities for the Anthrax prevention and control strategy. The County One Health Unit will act as secretariat to the CZC and the CZC will comprise of the following:

i. County Executive Committee Member for Health
ii. County Executive Committee Member for Agriculture Livestock and Fisheries
iii. County Director for Health
iv. County Director for Veterinary Services
v. County Commissioner

vi. County administrator
vii. County Wildlife Warden or equivalent officer at that level
viii. County Director of Environment
ix. Non-governmental organization(NGOs), Community based organizations (CBOs) and faith-based organizations (FBOs), training and research institutions
x. Representatives from professional and paraprofessional bodies
xi. Community representative

Roles of the CZC

- Coordinate Anthrax activities at the county level
- Update NAPCC on anthrax activities
- Advocacy and resource mobilization
- Oversee activities at sub-counties

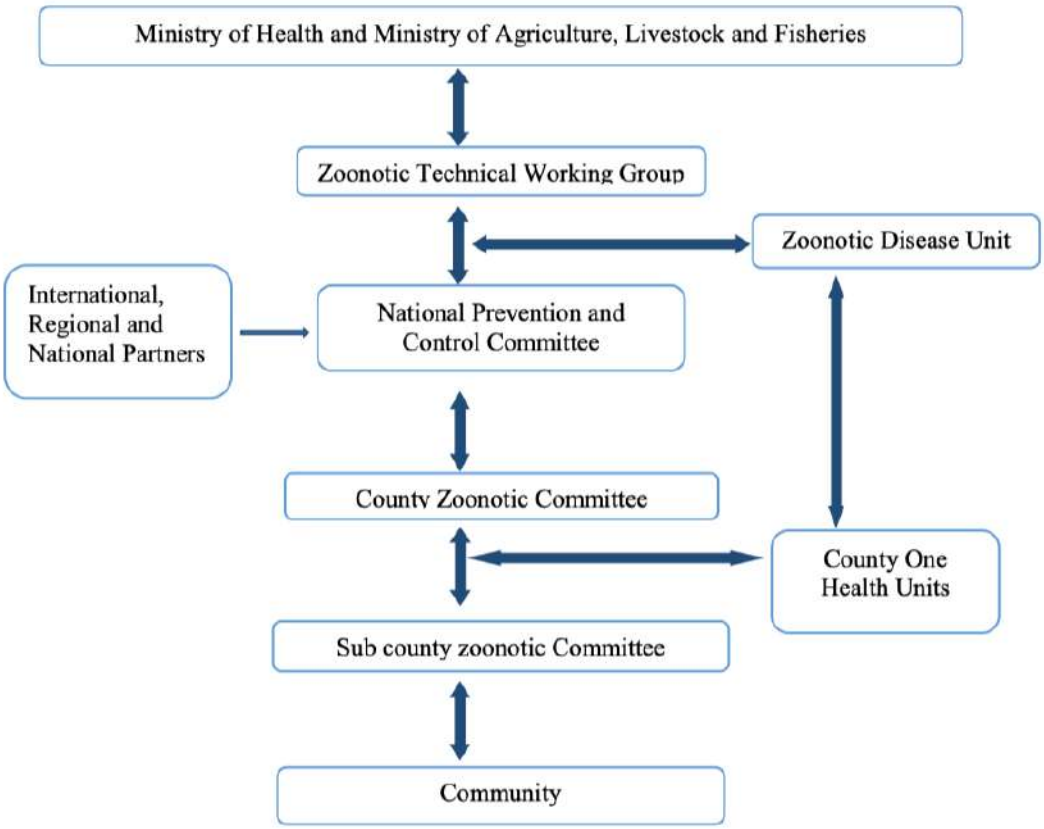


Figure 8: Schematic diagram showing coordination structure of the Anthrax prevention and control strategy.

4. Formation of Sub County Zoonotic Committee (SCZC)

The SCZC shall be formed at the sub-county level and will be co-chaired by the respective Sub-County Medical and Veterinary officers. The member of the SCZC will include;

i. Sub-county Medical Officer
ii. Sub-county Veterinary officer
iii. Deputy county commissioner
iv.Sub-county administrator
v. Community representatives
vi. NGOs, FBOs and CBOs representatives

Roles of the SCZC

- Implement anthrax prevention and control activities at the sub county level
- Promote public awareness
- Resource mobilization
- Regular updates to CZC

5. Identification of High Risk and Low Risk Zones

While Anthrax is endemic in Kenya, the disease is reported more often in certain areas than others. High-risk zones will be counties that have reported Anthrax outbreaks in both human and animals in the last five years (2014 to 2019). These will be identified through review of outbreak reports and risk mapping data. Within the high-risk zones, anthrax hotspots will be demarcated between one to 50km from an outbreak site depending on production systems. Any County with no reported Anthrax outbreak in the last 5 years will be considered to be Low-Risk. Any new outbreak in a low-risk County will move the county from low to high risk. Initial implementation activities including sustained vaccinations and enhanced surveillance will be done in the high-risk zones to demonstrate success and proof of concept.

Currently, available data from DVS shows that, Narok, Kiambu, Nyeri, Meru, Nakuru and Murang'a are the leading Counties in anthrax anthrax outbreaks over 60 years. Different counties have reported varying numbers of anthrax outbreaks over time as shown in (Figure 9). This will be used as the tentative risk map in the piloting phase as we await the 'real' risk map to be developed.

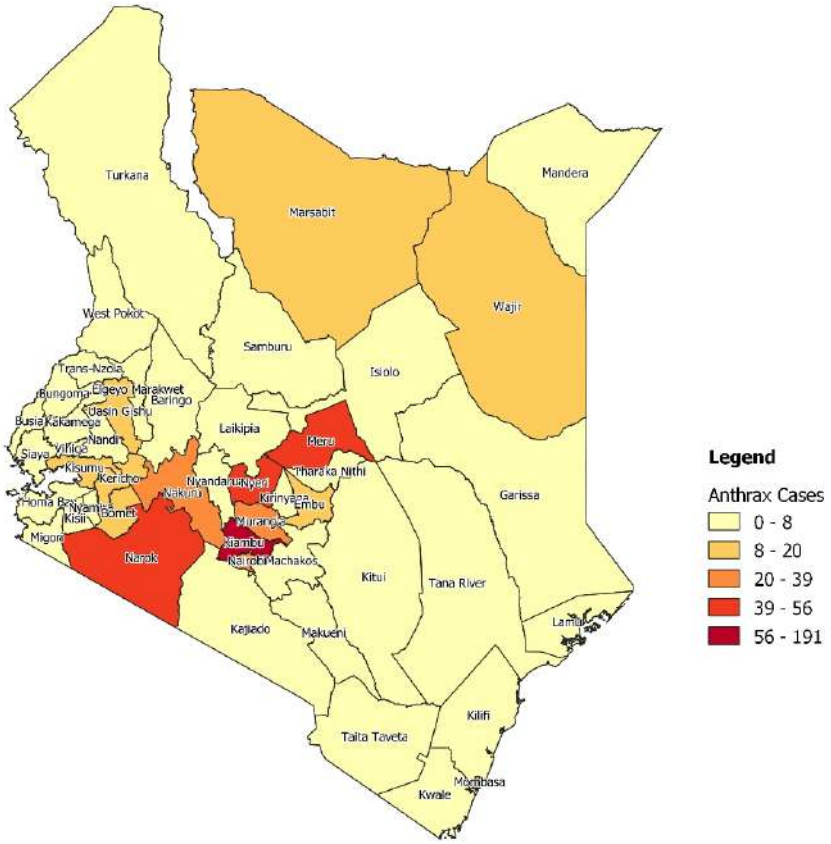


Figure 9: Spatial distribution of livestock anthrax outbreaks by counties in Kenya, 1957 to 2017 (Nderitu *et al.,* 2021)

A new outbreak in a low-risk county will be considered as a hot spot, and measures will be taken accordingly. The main activities undertaken in the high-risk zones will be sustained livestock vaccinations and enhanced surveillance. Successful implementation of these activities will demonstrate proof of concept that can be applied countrywide.

6. Strengthen Surveillance

Existing surveillance systems in MOH (IDSR), and MALF (KLWSS/KABS and laboratory surveillance) and rapid response will be enhanced to collect timely, accurate data on Anthrax in the country. Surveillance data to be collected will include;

i. Anthrax cases in humans and animals
ii. Livestock and wildlife vaccination figures
iii. Establishing a national Anthrax database based on surveillance data
iv. Improve capacity for human and animal health workers on case identification, notification, data management and outbreak investigation and response
v. Improve the capacity of veterinary and human laboratories for Anthrax diagnosis

7. Prevention and Control Measures

The prevention and control of animal anthrax will aim at reducing the economic effect associated with livestock loss, extinction of endangered wildlife species, environmental contamination and spill over to the human. Activities will include;

i. Developing a vaccination plan
ii. Enhance capacity for KEVEVAPI and other vaccine/drug producers/suppliers to provide high quality and affordable vaccines
iii. Developing training modules for animal health care workers on diagnosis, treatment, vaccination, proper disposal of carcasses, decontamination and disinfection of materials
iv. Developing training modules for human health workers on appropriate diagnosis & management of affected persons, infection prevention and control.
v. Sensitizing communities to adopt and embrace practices that promote Anthrax prevention and control

8. Information, Education and Communication

A communication plan will be developed to ensure responsible, accurate and informative reporting that promotes awareness and prevention of Anthrax in Kenya. Key components of the plan will include;

- Identification of audience
- Develop messages on awareness and risk reduction
- Public awareness campaigns
- Identify appropriate modes of communication
- Targeted communication for each stage of an Anthrax outbreak

Following the development of the communication plan, appropriate messages will be disseminated to relevant sectors

9. Promote and Co-ordinate Research

To support the implementation of the strategy, research of the following key components will be promoted;

i. Development of national Anthrax risk map
ii. Assessment of the economic impact of Anthrax
iii. Vaccine coverage studies
iv. Vaccine quality studies-vaccine validation, safety and efficacy
v. Effectiveness of vaccine delivery models
vi. Knowledge, attitude and practice (KAP surveys)
vii. Characterization of *B. anthracis*

NB; The government will be required to fund the research

10. Resource Mapping and Resource Mobilization

Resource mobilization is fundamental and central component of Anthrax prevention and control. Once resource mapping is done and the focus of work is set, resources are required to ensure successful implementation. This will involve;

i. Developing a resource mobilization and resource mapping plan
ii. Holding advocacy meetings with decision makers at the National and County levels

Key indicators for success in Phase 1:

- Resource map
- Adoption and operationalization of the Anthrax Prevention and Control Committees
- Existence of guidelines to support the implementation of the strategy
- National Anthrax committee and County zoonotic committee in high-risk zones
- Vaccination plan
- National database of Anthrax outbreaks in animals and humans
- Communication plan
- Anthrax risk map

5.1.2 Phase 2: Prioritized Implementation in High-Risk Zones, 2024-2027

This stage focuses on implementation of the prevention and control of anthrax in high risk zones. Activities for this stage will include;

- Advocacy, communication and social mobilization
- Collective training of human and animal health personnel and other relevant personnel on case identification and notification, diagnosis, biosafety and biosecurity, prevention and control measures and community mobilization
- Collating Anthrax outbreak data and feeding to national anthrax database
- Procurement and distribution of livestock vaccines, drugs and laboratory commodities
- Consecutive annual vaccination of livestock in high-risk zones, with vaccination coverage of at least 80%.to reduce outbreaks in humans and wildlife-based on the guideline
- Conducting impact assessments and economic cost analysis of the interventions
- Outbreak investigations and response in areas within and outside high-risk zones
- Enhancing existing anthrax surveillance system in the high-risk areas.
- Operational research and post-vaccination sero-surveillance
- Cross border engagements to reduce the risk of re-introduction of disease in the implementation areas
- Pre-positioning of vaccines, drugs and other consumables at national and subnational levels.
- Inter-county and international cross border engagement

Indicators to move from phase 2 to 3:

- Three- year consecutive vaccination of livestock in the high-risk zones with at least 80% vaccination coverage. After three years, vaccination will be targeted based on the epidemiological unit.
- Eighty percent (80%) of all anthrax cases reported are laboratory investigated
- Reduction of Anthrax human cases by 50% of the baseline
- Reduction of Anthrax incidences in livestock by 50% of the baseline
- Reduction of Anthrax cases at human-livestock-wildlife interface by 50% of the baseline

5.1.3 Phase 3: Implementation of Anthrax Prevention and Control Strategy in High and Low-Risk Areas, 2028-2032

This stage will involve full implementation of the strategy countrywide. Activities in this stage will focus on sustaining the achievements of stage two and expanding the lessons learnt to the other low risk zones. This will include;

i. Heightened anthrax surveillance in the entire country
ii. Sustaining livestock vaccinations
iii. Evaluation of the effectiveness of programs/ interventions
iv. Review and update of the national anthrax risk map

v. Research on economic impact and cost analysis benefit
vi. Advocacy, communication and social mobilization will continue in this phase
vii. Inter-county, regional and International cross border engagements
viii. Sustained and adequate vaccine stocks and resources for emergency response for containment of new outbreaks if they occur

Key indicators of success in phase 3:

a) Reduction of Anthrax cases in humans by 80% of baseline country wide
b) Reduction of Anthrax incidences in livestock by 80% of baseline country wide
c) Reduction of Anthrax cases at human-livestock-wildlife interface by 80%
d) Comprehensive vaccination coverage of 80% of the susceptible animals

5.1.4 Phase 4: Elimination of Anthrax in Humans, 2033-2036

In this stage, Anthrax elimination in humans is defined by:

- Zero human Anthrax cases in two years
- Reduction of animal Anthrax outbreaks by 90% of the baseline.
- Areas that do not report Anthrax outbreaks (in humans, livestock or wildlife) for two consecutive years are declared as achieved Anthrax elimination.
- Activities in stages 2 and 3 will be sustained in areas still reporting Anthrax cases.
- In areas declared free of Anthrax, surveillance will be sustained to detect new cases through zero reporting

Chapter Six

6.1 Monitoring and Evaluation

Routine monitoring, periodic assessment and evaluation will be done under the program at all levels to ensure implementation as per the strategy. Zoonotic Disease Unit and other stakeholders will develop a set of objectively verifiable indicators to measure progress and assess the achievement of the program in line with the strategy. In addition, an external independent evaluation will be done to assess the progress and indicate a necessary modification in program implementation strategies.

The NAPCC will conduct quarterly performance monitoring meetings to review the progress of implementation against targets in the annual work plan, address implementation bottlenecks and refocus as necessary.
Bi-annual stakeholder performance monitoring and review meetings at county and national levels will review performance against targets, address any constraints to implementation and refocus activities if needed.

Data audit: The national committee will conduct annual data quality audits and make official routine anthrax surveillance data available.

Annual review meeting: As part of the commitment to performance monitoring, all stakeholders will meet annually to review achievements against targets and milestones in the strategic and annual work plans. These meetings will also define and finalize priorities for the following year.

Table 5: Anthrax Prevention and control Workplan

Strategy	Objective	Activities	Indicators	Phase 1 2021-2023	Phase 2 2024-2027	Phase 3 2028-2032	Phase 4 2033-2036	Responsibility
1.Enhanced Coordination, collaboration and partnership	1.Strengthening capacity for coordination of the anthrax control and prevention plan	Development and adoption of the anthrax control and prevention plan	Anthrax control and prevention plan					MOH/MoALF/ Counties and other partners
		Identification of high risk and low Risk Zones	Anthrax Risk map developed					ZDU, Research & academic institutions
		Updating anthrax risk map	Risk map updated					ZDU, Research & academic institution,
		Development of anthrax control guidelines	Number of signed guidelines					MOH/MoALF/ Counties and other partners
		Establish and endorse National Anthrax committee and operationalize	Committee in place					MOH/MoALF/ Counties and other partners
		Establish and operationalization of zoonotic committees at county and sub county levels	Documented and functioning committees					ZDU, Counties and other stakeholders

Strategy	Objective	Activities	Indicators	Phase 1 2021-2023	Phase 2 2024-2027	Phase 3 2028-2032	Phase 4 2033-2036	Responsibility
1.Enhanced Coordination, collaboration and partnership	1.Strengthening capacity for coordination of the anthrax control and prevention plan	Conduct regional Inter-county ,regional and International cross border engagements meetings	Number of meetings documented					NAPCC
		Conduct quarterly technical meetings	Number of meetings documented					NAPCC
		Identify stakeholders and focal persons to Spearhead implementation of the anthrax strategy	List of stakeholders, Focal persons					ZDU
		Develop policy-advocacy plan to obtain buy-in from stakeholders	Policy Advocacy plan					ZDU and other stakeholders
		Develop anthrax legal framework in line with existing laws, strategy, policies and regulation	Legal frame work					MoH/MoALF
		Develop a budget for the implementation of the strategic plan and secure potential source of funding	Developed budget					ZDU and other stakeholders
		Develop monitoring and evaluation plan	Monitoring and evaluation plan					ZDU
		Conduct monitoring and supervision activities	Number of monitoring and evaluation reports. Number of supervision reports					NAPCC / CZC
		Conduct annual review meeting	Number of meetings					NAPCC / CZC
2.Surveillance, reporting systems and outbreak response	To assess and enhance the existing surveillance system	Evaluate the existing surveillance system and key indicators for anthrax reporting	Evaluation report					FELTP
		Collating anthrax outbreak data and feeding to anthrax database	Updated Anthrax data base					ZDU / NAPCC
		Conduct OH participatory epidemiology study. - Cross-sectional study – to develop a community based case definition.	lay Case definition in place					ZDU/CZC
		Provide trainings to build surveillance capacity among animal and public health surveillance officers	Number of trainings conducted Number of officers trained					ZDU
		Procure data collection and reporting tools/ equipment	Number of hard and soft data collection equipment					MOH/ MoALF and development partners
		Develop anthrax surveillance guidelines	Developed guidelines					ZDU
		Review and strengthen standard anthrax reporting format and channels	Defined Report formats and formal channels					ZDU, Technical partners e.g. OIE/WHO

Strategy	Objective	Activities	Indicators	Phase 1	Phase 2	Phase 3	Phase 4	Responsibility
				2021-2023	2024-2027	2028-2032	2033-2036	
2.Surveillance, reporting systems and outbreak response	To assess and enhance the existing surveillance system	Conduct quarterly review meetings, and biannual workshops with stakeholders	Number of meetings and minutes					NAPCC / CZC
		Prepare and share regular joint anthrax national surveillance reports and provide feedback to the regional level	Number of reports					ZDU
		Perform retrospective analysis and publication of surveillance data at regional and national level	Analysis report and publications					ZDU/ FELTP
		Develop a communication plan for public disclosure of anthrax outbreaks	Developed plan					ZDU
		Develop a national guideline and SOPs for outbreak investigation and response, case management, infection prevention, environmental sanitation, field investigation forms	Signed guidelines					ZDU
		Establish a OH joint national and county rapid investigation and response teams for anthrax outbreaks	Operational response teams					NAPCC / CZC
		Prepare outbreak preparedness plan and ensure availability of supplies (vaccines, drugs, human resource, laboratory consumables, and equipment) for anthrax outbreak investigation and response	Outbreak preparedness plan (updated on need basis)					NAPCC / CZC and other stakeholders
		Conduct simulation exercises, trainings on outbreak investigation, sample collection, handling and transportation	Number of simulation exercise					ZDU and other stakeholders
		Conduct/implement joint outbreak investigation and response	Anthrax investigation Reports					ZDU
3.Prevention and control of anthrax in animals	To enhance anthrax vaccine production, safety, quality, efficacy, distribution and rational use of the vaccine in animals	Quantify the national vaccine demand production, distribution and storage capacity of anthrax vaccine	Assessment report					DVS
		Develop and disseminate guidelines for vaccinations	developed and signed guidelines					DVS

Strategy	Objective	Activities	Indicators	Phase 1 2021-2023	Phase 2 2024-2027	Phase 3 2028-2032	Phase 4 2033-2036	Responsibility
3.Prevention and control of anthrax in animals	To enhance anthrax vaccine production, safety, quality, efficacy, distribution and rational use of the vaccine in animals	Plan and implement vaccination campaigns and vaccination coverage determination methods	Doses used and vaccination reports					DVS /CDVS
		Impose and enforce quarantine and livestock movement restriction when needed	Number of Quarantine imposed					DVS /CDVS
		Improve KEVEPAPI vaccine production capacity to meet the estimated national demand	Vaccines produced					MoALF
		Automation of the vaccine supply chain management system and SOP for monitoring of vaccine, production, distribution, handling, storage (cold chain) and administration	Automated supply chain management system and SOPs					DVS/ CDVS
		Establish effective vaccines disposal system (expired, damaged, and inappropriately stored)	Vaccine disposal system in place					DVS/ CDVS
		Training animal health professionals and technicians on vaccine handling, transport, storage and administration, cold chain maintenance and calibration	Number of trained animal health personnel					DVS/ CDVS
		Develop SOP for proper destruction and disposal of infected animal carcasses, identification and protection of animal burial sites and disinfection of contaminated materials and premises	Developed SOPs					DVS/ CDVS
		Ensure availability of the necessary supplies and equipment's (PPE) for disinfection/ environmental sanitation	Adequate Supplies in the stores					MoALF
		Train animal health workers on sanitary measures	Number of trained personnel					DVS / CDVS
		Conduct community education and awareness on anthrax prevention and control	Number of awareness barazas held					DVS / CDVS

Strategy	Objective	Activities	Indicators	Phase 1 2021-2023	Phase 2 2024-2027	Phase 3 2028-2032	Phase 4 2033-2036	Responsibility
4.Anthrax prevention and control in Human	Enhance safety regulations in handling suspected and confirmed anthrax cases	Educate human health workers on detection of anthrax, effective treatment of anthrax and infection prevention and control	Number of meetings held					MoH
4.Anthrax prevention and control in Human	Enhance safety regulations in handling suspected and confirmed anthrax cases	Public education on the risks, prevention and control of anthrax specifically targeting high-risk populations	Number of barazas held					MoH/MoALF
		Community awareness in handling suspected and confirmed cases such as wearing protective clothing, improve food and occupational hygiene; avoid all blood-spilling operations such as slaughtering infected or suspect animals/ carcasses; appropriate disinfection measures before coming into contact with other persons or animals	Number of barazas held					MoH
		Prompt identification and treatment of affected people and prophylaxis of exposed individuals	Number of people given prophylaxis					Public health professional
		Training of health workers on standard precautions and safety regulation	number of trained health workers					MoH
5.Anthrax Diagnostic Laboratory Capacity	Improving national and regional animal and public health laboratory capacity for anthrax diagnostic testing	Assess national and regional public and animal health laboratory capacity for anthrax diagnostic testing	Assessment report					DVS, MoH
		Prepare a laboratory development plan	Developed plan					ZDU
		Organize trainings for public and animal health laboratory professionals and field staff (sample collection, preservation and transport, submission, reporting and confirmatory diagnosis)	Number of trained personnel					ZDU
		Procurement of adequate and necessary laboratory supplies and equipment	Procured supplies					MoH,MoALF
	Establish and enhance inter-sectoral inter-laboratory networking (public and animal health)	Establish an inter-laboratory resource sharing networking mechanism such as memorandum of understanding (MoU) and terms of reference (ToR)	Signed MoU and ToRs document					MoALF, MoH
		Organize quarterly inter-laboratory fora (networking, information sharing, joint plan	Number of fora					ZDU

Strategy	Objective	Activities	Indicators	Phase 1 2021-2023	Phase 2 2024-2027	Phase 3 2028-2032	Phase 4 2033-2036	Responsibility
5.Anthrax Diagnostic Laboratory Capacity	Maintaining anthrax biosafety and biosecurity	Review laboratory sample SOPs for biosafety, biosecurity, handling, transport, processing and testing	Reviewed SOPs					MoALF, MoH
6.Information, Education and Communication	Increasing community awareness and behavioral change regarding anthrax prevention and control	Develop a communication plan	Developed plan					ZDU
		Develop and disseminate audience specific IEC materials	Disseminate IEC materials					ZDU
		Train health professionals on communication strategy, risk communication and messaging	Number of trained professional					ZDU
		Sensitize community on risk related to butchering dead carcasses, improper disposal of anthrax confirmed cases (biosecurity measures) and good husbandry practices	Number of Sensitization barazas held					ZDU/CZC
		Assess the knowledge and skills (KAP) of the professionals	KAP publication and report					FELTP
		Review existing educational materials for professionals	Updated educational materials					ZDU
		Develop training manuals and provide training to public, animal and environmental health professionals	Published Manuals and number of trained professional					ZDU
		Perform field level testing of the developed educational materials	Approved field education materials					NAPCC
		Distribute information and educational materials to relevant sectors	Distributed educational materials					NAPCC / CZC
7. Conduct and promote operational research	Supporting applied and operational research initiatives and use research findings to support implementation	Identify and implement research on the burden of anthrax in the country, economic impact and cost benefit analysis, vaccination coverage and sero-survey, efficiency of current vaccines, vaccine delivery model	published papers, reports					MoH, DVS and research institutions
		Introduce anthrax rapid diagnostic field tests; research on new testing method	Functional rapid test kit					MoH, DVS and research institutions

Strategy	Objective	Activities	Indicators	Phase 1 2021-2023	Phase 2 2024-2027	Phase 3 2028-2032	Phase 4 2033-2036	Responsibility
8.Resource mobilization	Seeking resources from state and non-state actors towards implementation of the anthrax prevention and control	Develop comprehensive anthrax prevention and control budgets and justifications	Budgets					ZDU
		Resource mapping	Needs assessment Report					ZDU
		Advocate for budgetary allocation by the National and County governments	Approved budgets					NAPCC / CZC
		Invite interested development partners to participate and manage aspects of the program	number of meeting held, invitation letters					NAPCC/ZDU

Appendix 4: List of Contributors

NAME	INSTITUTION
Dr. Athman Mwatondo	MOH- ZDU
Dr. Mark Nanyingi	University of Liverpool/UoN/FAO-ECTAD
Dr. Mathew Muturi	MALF -ZDU
Dr. Harry Oyas	MALF- VEES
Dr. Stephen Gathogo	MALF- Garissa County
Dr. Romona Ndanyi	MALF-CVL
Dr. Micheal Kahara	MALF-CVL
Dr. Eunice Omondi	MALF-CVL
Dr Carolyne Nasimiyu	MOH- ZDU
Mr. Mathew Mutiiria	MOH- ZDU
Mr. Julius Kimitei	MOH- ZDU
Ms. Angela Mukami	ZDU
Dr. Lekopien Argeo	FELTP
Dr. Maurice Omondi	FELTP
Dr. Joseph Maina	MOH-Narok
Dr. Augusta Kivunzya	MALF- Kitui County
Prof. Lilly C. Bebora	University of Nairobi
Dr. Lilian Waiboci	University of Nairobi
Dr. Nickson Lang'at	University of Nairobi
Dr. Kennedy Mochabo	University of Nairobi
Dr. Hope Kameta	University of Edinburgh
Dr. Penina Munyua	CDC-Kenya
Dr Okunga Emmanuel	MOH- DSRU
Mr.Jackson Njoroge	MOH- DSRU
Dr. Zelalem Tedesse	FAO
Dr. Mark Obonyo	FAO
Dr. Stella Kiambi	FAO
Mr. Evans Tenge	FAO
Mr. John Njuguna	FAO
Dr. Mathew Mutinda	Kenya Wildlife Service
Dr. Isaac Lekolol	Kenya Wildlife Service
Dr. Ezekiel Bowen	MOH- Nakuru County
Dr. Githui Kaba	MALF- Nakuru County
Dr. Peter Wang'ombe	MOH- Meru County
Dr. Missi Mutungi	MALF- Meru County
Ms. Caroline Mbogori	MOH-NPHL
Mr. Wilson Kung'u	MOH-NPHL
Dr. Thomas Nyariki	Consultant
Dr. John Mwaniki	KEMRI
Dr. Eric Osoro	Washington State University
Dr. Isaac Ngere	Washington State University
Prof. Eric Fevre	University of Liverpool and ILRI
Ms. Lorraine Alumasa	ILRI
Dr Andrew Thaiyah	USAID-GHSA
Dr. Victor Okoth	Ufya Ugavi
Dr. Jones Mutua	KEVEVAPI

References

1. Turnbull PCB. Introduction: Anthrax History, Disease and Ecology. :1–19.

2. World Health Organisation. in humans and animals. i Anthrax n humans Anim. 2008;(Fourth edition).

3. Muturi M, Gachohi J, Mwatondo A, Lekolool I, Gakuya F, Bett A, et al. Recurrent Anthrax Outbreaks in Humans , Livestock , and Wildlife in the Same Locality ,. 2018;99(4):833–9.

4. Misgie F, Atnaf A, Surafel K. A Review on Anthrax and its Public Health and Economic Importance 1. 2015;4(3):196–204.

5. Diseases ZI. Framework for Enhancing Anthrax Prevention & Control.

6. Shadomy S, Idrissi A El, Raizman E, Bruni M, Palamara E, Pittiglio C, et al. empres watch. Empres Watch. 2016;37(september).

7. Carlson CJ, Kracalik IT, Ross N, Alexander KA, Hugh-jones ME, Fegan M, et al. and wildlife. Nat Microbiol [Internet]. Available from: http://dx.doi.org/10.1038/s41564-019-0435-4

8. Vieira AR, Salzer JS, Traxler RM, Hendricks KA, Kadzik ME, Marston CK, et al. Enhancing Surveillance andDiagnostics in Anthrax-Endemic Countries. 2017;23(December).

9. Animal diseases Act. 2015;

10. Case A, Griffith J, Blaney D, Shadomy S, Lehman M, Pesik N, et al. of Inhalation. Dispatches. 2014;20(2).

11. Munyua P, Bitek A, Osoro E, Pieracci EG, Muema J, Mwatondo A, et al. Prioritization of Zoonotic Diseases in Kenya ,. 2016;(August).

12. Nderitu, L.M., Gachohi, J., Otieno, F. et al. Spatial clustering of livestock Anthrax events associated with agro-ecological zones in Kenya, 1957–2017. BMC Infect Dis 21, 191 (2021).

13. Muoria PK, Muruthi P, Kariuki WK, Hassan BA, Mijele D, Oguge NO. Anthrax outbreak among Grevy ' s zebra (Equus grevyi) in. 2007;483–9.

14. Blackburn JK. Ante And Postmortem Diagnostic Techniques for Anthrax : Rethinking Pathogen Exposure and The Geographic extent of the Disease in Wildlife. 2013;49(4):786–801.

15. WHO(2008), Anthrax in humans and Animals (4th Edition).

16. DTRA (2009), Economic Impacts of a Wide Area Release of Anthrax. (May 2009)

17. Chakraborty A, Khan SU, Hasnat MA, Parveen S, Islam MS, Mikolon A, et al. Anthrax Outbreaks in Bangladesh , 2009 – 2010. 2012;86(4):703–10.

18. Kaitho T, Ndeereh D, Ngoru B. An outbreak of anthrax in endangered Rothschild ' s giraffes in Mwea National. 2013;45–8.

19. Engida E, Guthiga P, Nyota H, Karugia J. Ermias Engida, Paul Guthiga, Hannah Nyota and Joseph Karugia. (37).

20. Food and Agriculture Organization of the United Nations. Case Definition of Livestock Diseases. 2010;39.