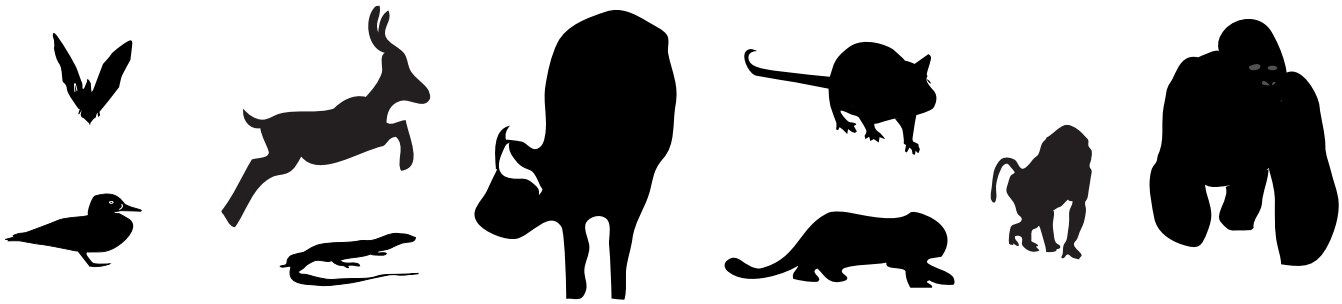
HALÍ

Wildlife Health Handbook

Recognizing, Investigating, and Reporting Diseases of Concern for Wildlife Conservation and Human Health

A Guide for Protected Area Rangers, Scouts, and Staff

Deana L. Clifford
David J. Wolking
Epaphras Alex Muse



HALI

WILDLIFE HEALTH HANDBOOK

Recognizing, Investigating, and Reporting Diseases of Concern for Wildlife Conservation and Human Health

A Guide for Protected Area Rangers, Scouts, and Staff

Deana L. Clifford
David J. Wolking
Epaphras Alex Muse

Illustrations by Andrea Kulkarni

Kiswahili Translation by David Ngoseck Mollel

UC DAVIS
VETERINARY MEDICINE
Wildlife Health Center

HALI Wildlife Health Handbook

Published in North America by
the Health for Animals and Livelihood Improvement
(HALI) Project

Please copy this book!
PDFs of the handbook
are available for download at:
http://www.vetmed.ucdavis.edu/whc/programs/hali.cfm

We encourage anyone interested in translating this handbook to contact the authors
to avoid duplication of efforts and for suggestions for
adaptation of the book.

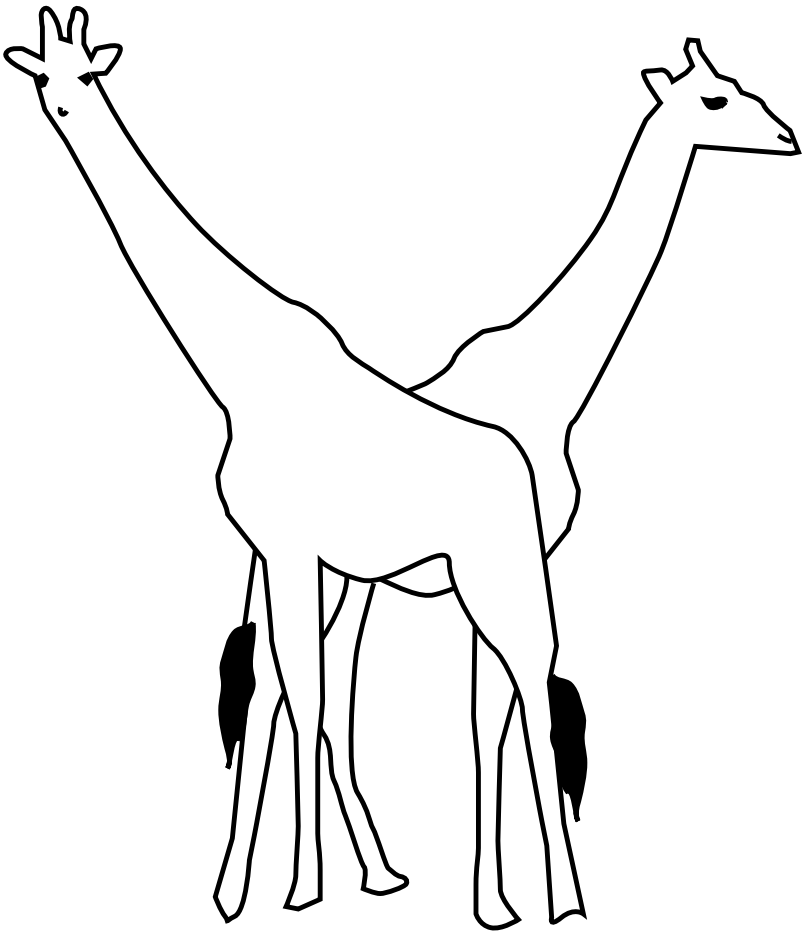
We would greatly appreciate receiving a copy of any materials in which
text or illustrations from this book have been used,
or receiving information about how this book is being used in the field.
Contact Deana Clifford: wildlifehealth@ucdavis.edu

The Health for Animals and Livelihood Improvement (HALI) Project is a "One Health" focused collaborative US-Tanzania research and capacity-building program aimed at assessing the effects of zoonotic disease (diseases which can be passed between animals and people) and water management on health and livelihoods in the Ruaha ecosystem, Tanzania. Project partners include the Sokoine University of Agriculture, the Tanzania National Parks, the Tanzania National Institute for Medical Research, University of California, Davis Wildlife Health Center, the University of California, San Francisco, and the University of Vermont. More information about HALI can be found at http://haliproject.wordpress.com

Asanteni sana!

The creation of this guide would not have been possible without the funding provided by the United States Fish and Wildlife Service Division of International Conservation Wildlife Without Borders Program grant # 96200-9-G229.

We are very grateful to Andrea Kulkarni for her beautiful illustrations. We are also grateful to Rudovick Kazwala, Alison Kent, Jonna Mazet, Woutrina Miller, Godwell Ole Meing'ataki, David Ngoseck Mollel, Harrison Sadiki, and Elizabeth VanWormer. Thanks are also due to the rangers, ecologists and warden staff from Ruaha National Park, and the community game scouts and leadership from the Matumizi Bora ya Malihai Idodi na Pawaga (MBOMIPA) Association for their continued collaboration, and for being willing and engaged participants in our first classes. Asante!



Purpose of this handbook

The goal of this handbook is to enable protected area rangers, game scouts, and park staff to safely recognize, investigate, report, and respond to disease events that may impact the conservation of wildlife and threaten human health. The content in this handbook is adapted from a 2-day short course for park rangers and game scouts developed by the HALI Project and Ruaha National Park veterinarians and ecologists. Wherever possible we recommend this handbook be used in conjunction with a hands-on practical training course.

The material presented in this handbook will help rangers, game scouts, and park staff be able to:

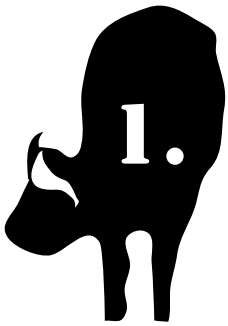
1. Recognize the signs of diseases of conservation significance and zoonotic disease in wild animals, including rabies, bovine tuberculosis, and anthrax.

2. Understand how diseases are transmitted between wildlife, domestic animals, and people. Transmission through work exposure, food (milk, meat, bush meat), and environmental routes will be emphasized.

3. Assist with the investigation of disease and poisoning events in wildlife. Specific skills include how to recognize that a disease event may be occurring, basic necropsy, sample collection methods, and reporting of suspected disease events.

4. Protect themselves from exposure to zoonotic diseases during their normal work duties.

Contents



Understanding Disease in Animals and People

Wildlife in our protected areas are under pressure from a variety of threats, including drought, poaching, fires, and habitat destruction. Another threat to wildlife conservation is disease.

Section 1. The Impact of Disease in Wildlife Populations

What is disease? Disease is an impairment of health or a condition of abnormal functioning, like a runny nose or swollen lymph nodes that can make animals and people feel sick.

Infectious diseases are caused by living organisms called pathogens. Examples of pathogens are viruses, bacteria, fungi, and parasites (See Table 1). Disease can result in death of the animal. Some diseases may not kill the animal, but may make it weak and vulnerable to predation or poaching. Other diseases may kill only very young animals or impair reproduction.

If there is adequate water, food, and good habitat, most wildlife populations can tolerate a low level of disease. But, in wildlife populations that are already experiencing difficult living conditions including negative environmental pressures like drought, limited food and diminished or degraded water resources, diseases can be a significant threat to conservation. Disease may result in die-offs of a large number of animals. If this occurs in a normally rare species, like an African wild dog, an entire population may become extinct. For example, in the 1990s an outbreak of rabies eliminated African wild dog populations in the Serengeti National Park.

Even if a disease does not cause the deaths of large numbers of animals, it can still have conservation impacts. For example, if the disease causes illness and poor body condition, the animal population may be more vulnerable to drought and fluctuations in food availability. Disease may also cause a population decline by reducing the number of animals that are born or by reducing the survival of young animals. Furthermore, if there are fewer animals, and/or more animals in poor condition, tourism revenues may decrease and hunting revenues could be affected in protected areas that allow hunting. So, disease can impact conservation not only through the reduction in animal populations, but also by reducing the economic revenues needed to support the protected areas and surrounding communities.

Section 2. Disease transmission routes in an ecosystem

The process of how a pathogen that causes disease spreads from animal-to-animal or animal-to-human is called transmission.

What is disease transmission? Disease transmission is a successful transfer or shift of disease pathogens from one sick individual to another making the other individual sick. First, the pathogen enters a person or animal that is vulnerable to disease. Then the pathogen reproduces inside the animal or person that has been **infected**. After this step, the sick animal or human passes the pathogen to another susceptible animal or human to continue the disease process.

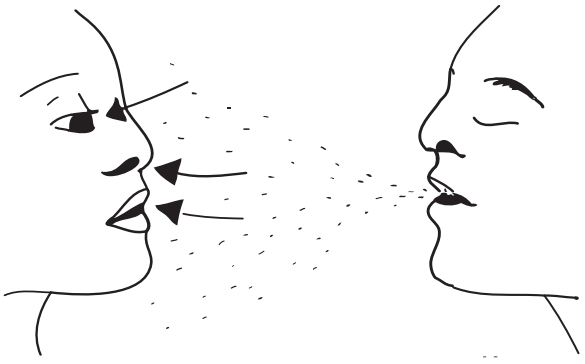
There are many different routes that pathogens can use to be transmitted among animals or between humans and animals. In addition, some diseases can be transmitted by more than one route. We describe these transmission routes below, so you can learn how disease spreads in animals and people and increase your ability to prevent the spread of a disease.

Transmission by Direct Contact: This transmission route involves direct contact with a pathogen from an infected animal or from the environment. An animal or human can be infected when the pathogen directly touches open wounds, abraded skin, or the mucous membranes (thin layers of tissue covering the linings and cavities of the body like the eye, nose, and mouth). Transmission can also occur through bites and scratches, and, rarely, through direct penetration of the skin. Anthrax and rabies are examples of diseases that are directly transmitted. Anthrax bacteria can enter directly through cuts in the skin. The rabies

virus is transmitted when an infected animal bites another animal or person.

Transmission through Reproduction (Direct Contact): This type of transmission occurs when the pathogen is present within the tissues or fluids eliminated during the delivery of newborn animals. New animals become infected by directly contacting these tissues, usually by sniffing, or ingesting. Brucellosis, a bacterial disease affecting livestock and wildlife, can be transmitted to other animals or people that have direct contact with placental tissue or aborted fetuses. Additionally, some infectious diseases can be spread during breeding or in the uterus from the mother to her offspring.

Transmission in Air Droplets (Aerosol): Pathogens can be transmitted between animals or from animals to humans in air droplets, usually through the action of coughing or contact with saliva. The infected and susceptible animal or person need to be in close proximity to each other because the pathogen cannot travel far in the tiny droplets. Tuberculosis bacteria and the common cold virus are both transmitted in the tiny air droplets released by a person that is coughing. Canine distemper virus, a disease that causes respiratory infection, seizures and often death in carnivores, is also transmitted between carnivores by air droplets.



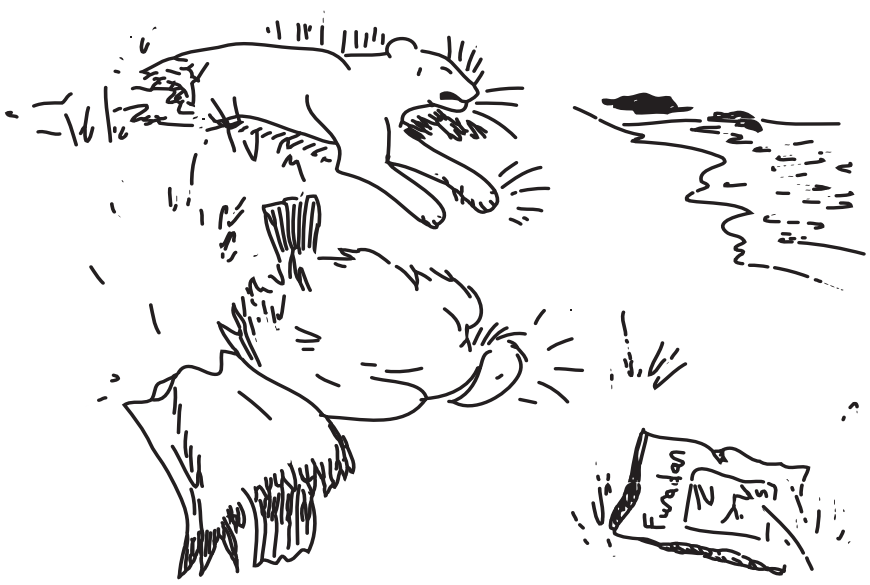
Oral Transmission: This occurs when a person or animal ingests a pathogen present in contaminated food or water, or when animals lick or chew contaminated objects in the environment. Water sources contaminated with feces or urine are most often the cause of oral transmission of diseases, including cholera. Drinking unboiled surface water containing the cholera bacteria can cause diarrheal disease in people and animals.

Transmission by Objects (Fomite): If inanimate objects like blankets, cages, equipment, clothing, shoes, and buckets become contaminated by an infected animal, the pathogen can be moved from place to place. A susceptible animal or human who then contacts the object can become infected. Sarcoptic mange, a skin disease causing intense itching, redness, and infection can be transmitted from animals-to-animals, animals-to-people, or people-to-people if clothing or blankets contaminated with the parasite (a mite) contact the skin of a new animal or person.

Insect & Tick-borne Transmission (Vector-borne): Many diseases are transferred among animals or people by ticks or insects. The tick or insect acquires the pathogen from feeding on an infected animal or person, and then transmits the pathogen to another animal or person. For example, malaria is transmitted among people by mosquitoes. The mosquito acquires the malaria parasite when feeding on the blood of an infected person, then transfers the parasite when it bites another person.

Environmental (Common Source): Some pathogens can survive for a long time in soil or the environment, and can then be acquired by animals or humans through inhalation (aerosol), oral consumption, direct contact, or via objects. Anthrax is a bacteria that can survive for many years in the soil.

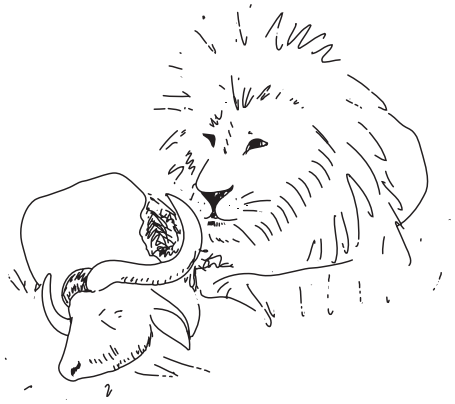
Common source transmission can also include exposure to substances other than living pathogens, for example poison. Common Source transmission is the most frequent way animals and people are exposed to poisonous toxins like pesticides, herbicides, and heavy metals.



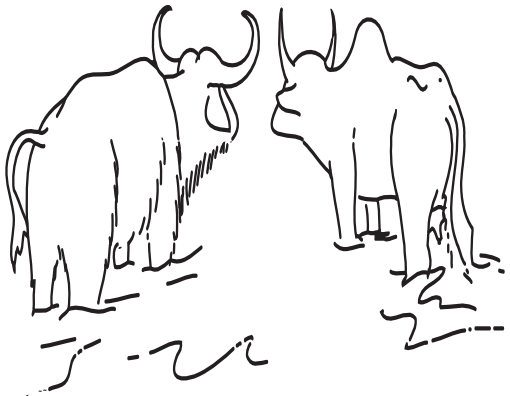
Bovine Tuberculosis (BTB) is a disease that can infect animals and people by multiple transmission routes.

Transmission to Animals

BTB can be transmitted between buffalo through air droplets.



Lions and other carnivores can get BTB by eating an infected buffalo.



BTB can be transmitted between cattle and wildlife by air droplets or the environment at shared sites like watering holes.

Transmission to People

People can be infected with BTB by drinking raw (unboiled) milk from an infected cow.

Another way for pepole to become infected is during slaughter or by consuming undercooked meat.

People can also get infected by having close contact with cattle or keeping cattle inside the house.

How do you prevent disease transmission?

W	A	S	H
WASH	**AVOID**	**SAFETY**	**HEALTH**
Wash hands with water and soap. Wash before preparing food, eating, or having contact with infants and children. Wash after touching animals or using the restroom.	Avoid touching wildlife and domestic animals unless prepared to work with them. Avoid disease transmitting vectors like mosquitoes, ticks, and fleas and their vector areas (wooded areas, stagnant water) and times of day vectors are active (dawn and dusk) – unless properly prepared.	Wear appropriate personal protective equipment (PPE) when working with animals or when going out into the field. Long sleeves and pants protect you from direct contact and vectors. Wash food and cook milk and meat products to prevent oral transmission.	Be sure to report any contact (bites, scratches) or signs of illness immediately to your health clinic. If possible, make sure you are vaccinated for rabies and other disease risks.

W.A.S.H. adapted from the Iowa State University Center for Food Security and Public Health Zoonotic Disease Prevention Assets: www.cfsph.iastate.edu/Zoonoses_Textbook/Assets/WASH_zoonotic_disease_prevention.pdf

Section 3. Zoonoses – An Important Group of Diseases

What is Zoonotic Disease?

Many of the diseases that affect wildlife can also be transmitted to people. Diseases that can be transmitted from animals to people are called **zoonotic diseases** or **zoonoses**.

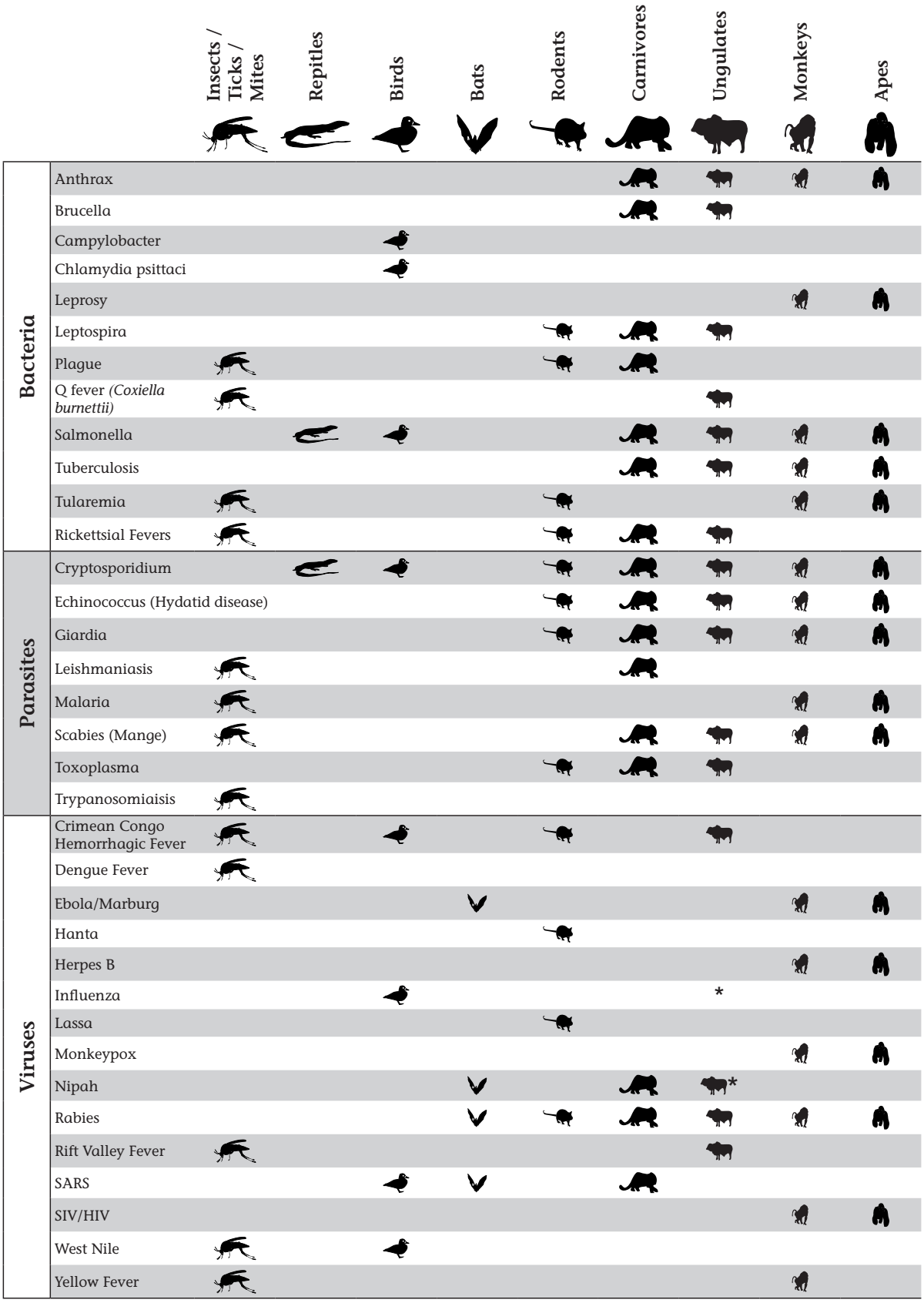
It is very important that park rangers and game scouts know which diseases can be transmitted from animals to people, as your health and the health of other park staff and visitors could be at risk.

Diseases can be transmitted between wildlife, livestock, and other domestic animals. Many of these same diseases also infect humans. Tuberculosis (a bacterial disease that affects the lungs), for example, can infect wildlife like buffaloes as well as cattle and small ruminants, dogs, cats, and even the people who care for them.

For this reason, game scouts and rangers should also be aware of diseases occurring in livestock or people that live around the wildlife protected areas. These diseases may spread to the wildlife from domestic animals outside of the park, or even from wildlife to the domestic animals, causing conflict with local communities. Table 1 describes the animal hosts and insect vectors for some important zoonotic diseases that can threaten conservation and animal health.

In the next section we will discuss how to recognize when a disease is occurring (a disease event).

Table 1: Important Zoonotic Diseases and their Common Hosts



* Pigs, suids

Section 4. How to Detect Disease Events and Outbreaks

Now that you know the basic biology of diseases and why disease can be an important threat to both wildlife conservation and human health, we will review how to detect a disease or toxicity event.

What is an outbreak?

A certain amount of illness is normal in animals and people. However, when a pathogen starts making an abnormally large number of animals or people sick, or even killing them, it is called an **outbreak**.

What might be causing the animal die off in this scene?
Is this an outbreak?

How do you recognize an outbreak?

The first sign of a disease outbreak is often the observation of an unusually high number of dead or sick animals within a short period of time or in a certain place. Predators and scavengers may congregate at the site of a die-off. Sometimes, as in the case of a toxin or anthrax, multiple species may be observed sick or dead near a common water source.

Any time an unusual number of animals are found dead, disease or a toxin must be considered.

Look for abnormal behavior!

Some diseases do not kill the animal right away, but instead cause the animal to exhibit abnormal behavior. Rabies can cause carnivores to become overly aggressive, lose their natural fear of humans, produce large amounts of saliva, and have seizures or other behavior changes. Rabies should be suspected for any domestic or wild carnivore that becomes aggressive towards people or other animals without being provoked.

Other signs of disease might be less obvious, but could include weight loss, reduced activity, and poor reproduction through abortion or poor survival of offspring. Sometimes, the only sign of a disease event may be the absence of animals in an area where they were commonly found. **The key to recognizing more subtle signs of illness is to have a good understanding of the normal behavior,** foraging habits, and reproductive cycles of the wildlife species in the protected area where you work.

Rapid detection of a disease or toxicity event will help:

- Prevent the spread of the disease or toxin to other animals or people
- Reduce the number of deaths
- Reduce negative conservation impact
- Most important, quick detection of a zoonotic disease event will help reduce the threat of the disease being transmitted to and harming people.

What should I do in case of a suspected outbreak?

If you suspect a disease event or outbreak is happening, **report your observations to the ecologist, veterinary contact, or local authority** designated for the protected area you are working in. Be sure to record important details such as the species and types of animals that are affected, how many animals have died or are sick, what signs of illness the animals are showing if they are sick, how long these signs have been observed (e.g. how long this disease event has been occurring), and the location(s) where the sick or dead animals are being found.

We have provided a form in the Appendix of this handbook to assist in reporting a disease event. Part 3 provides a series of exercises to practice recognizing and responding to a disease event and/or outbreak.

Reporting and Safe Investigation of Wildlife Disease Events

Section 1. Protecting Yourself from Disease

It is important to protect yourself from disease causing pathogens when working with wildlife, domestic animals, and their carcasses.

How do people get infected when working with animals? The most common way people get infected with a disease while working with animals is by touching animal carcasses or body parts with their bare hands, then rubbing their eyes or touching their mouth. Another important transmission route is inhalation of aerosolized body fluids during butchering or sampling of carcasses. A third common way is if the infected fluids or parts of an animal come into contact with a cut or abrasion on a person's skin. Clothing or other objects that have been in contact with a sick animal can also transmit disease to people or move a disease into a new area.

It is easy to prevent infection by taking actions to "block" the disease agent from entering your body.

Avoid touching your face with your hands at all times when working with live animals or animal carcasses. If you are bitten or scratched by a wild or

The single most important thing you can do to stay healthy is to wash your hands after handling live animals, animal carcasses, or animal parts such as meat, organs, or feces.

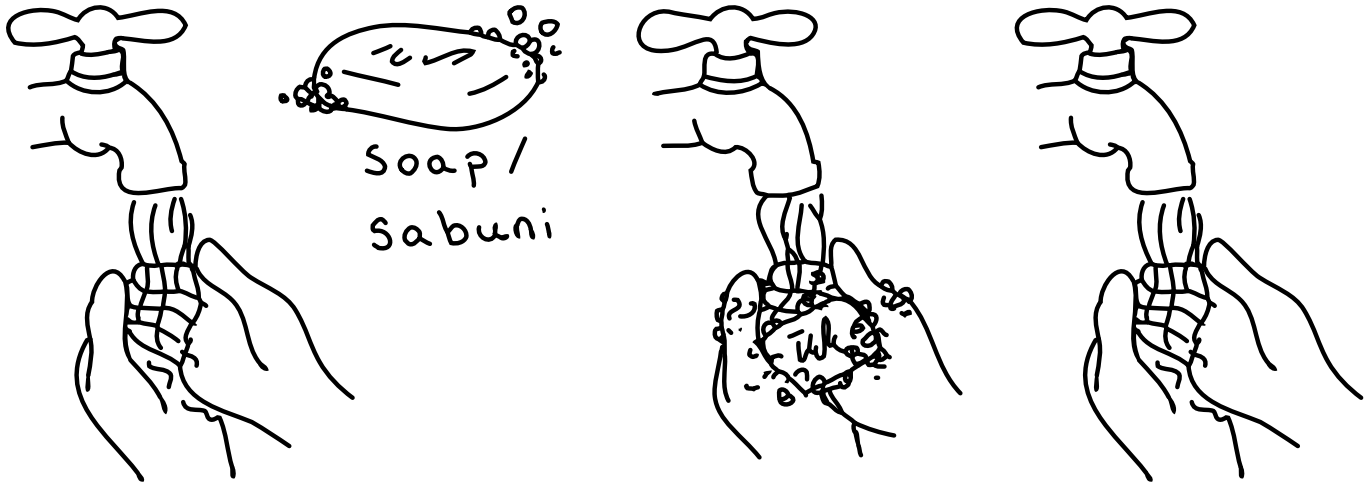
domestic animal, immediately wash the wound vigorously with soap and water.

How should I wash my hands? This seems like a funny question to ask because we wash our hands so frequently. But washing our hands to remove dirt, and washing our hands to protect ourselves from dangerous pathogens are very different. The box below provides a guide for when and how we should wash our hands to stay safe from disease.

When to wash your hands:*	
Always wash your hands before:	**Always wash your hands after:**
Handling animals	Touching an animal, samples, harnesses, or waste
Preparing food	Preparing foods, especially raw meat or poultry
Eating	Using a toilet
Treating wounds or administering medications	Changing a diaper
Contact with a sick or injured person or animal	Blowing your nose, coughing, or sneezing into your hands
	Treating wounds or touching a sick or injured person

**Adapted from the PREDICT Safety Guide: Biosafety and PPE Use*

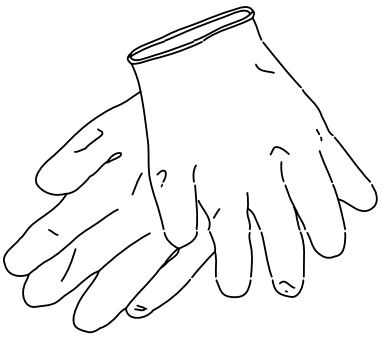
Hand Washing Technique:



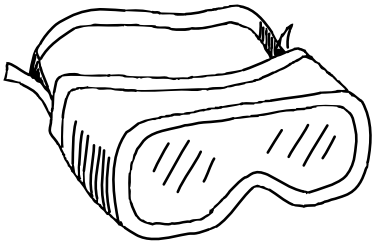
Wet hands with water — *Use liquid, bar or powder soap* — *Work up a lather for 15-20 seconds* — *Wash under and around nails* — *Rinse hands*

In addition to washing hands, a few basic items and practices can help protect you from disease exposure.

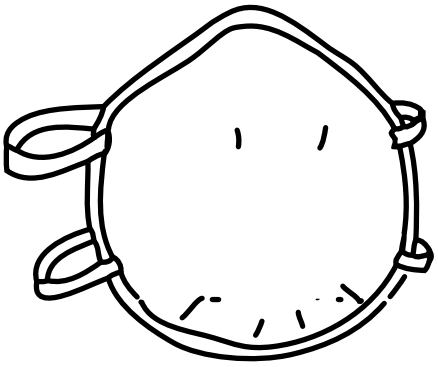
The 5 P's:



1. Protect your hands with disposable gloves: Wearing disposable gloves will protect your hands from being contaminated with a pathogen and serve as a visual reminder for people not to touch their face, mouth or eyes. In an emergency, a plastic bag can be used as a barrier between your hands and the animal; but be aware that a plastic bag is not designed for protection, and is NOT as safe as gloves.

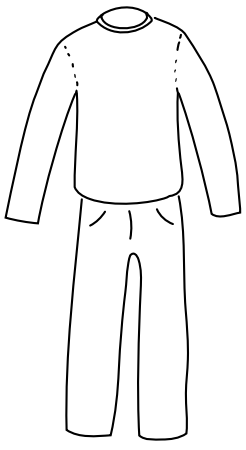


2. Protect your eyes with glasses or a face shield: It is easy for tiny droplets of blood or contaminated material to get into your eyes. Often this happens when a person with dirty hands rubs their eyes. Always remember not to touch your face or rub your eyes when working with animals! Wear glasses or a face shield to protect your eyes. A simple pair of sunglasses will help protect you if proper glasses or a face shield are not available.



3. Protect your nose and mouth with a mask: People often ingest a pathogen when they accidentally touch their mouth with dirty hands. Wearing a mask will also protect you from inhaling pathogens that may be present in air droplets. If a mask is not available, and you have no alternative, you can tie a handkerchief or scarf over your nose and mouth. This will protect you from touching your hands to your mouth, but will NOT protect you from pathogens that may be present in air droplets. Like using a plastic bag as a substitute for gloves, and sunglasses in place of protective glasses, scarves and handkerchiefs are NOT designed to protect us from pathogens and are less safe.

4. Protect your feet with covered shoes: It is easy for people to get exposed to disease if their feet get blood, feces, or urine on them. Many people have small cuts or abrasions on their feet. Prevent skin exposure on your feet by wearing covered (close-toed) shoes. Wear shoes that are easy to wash after working.

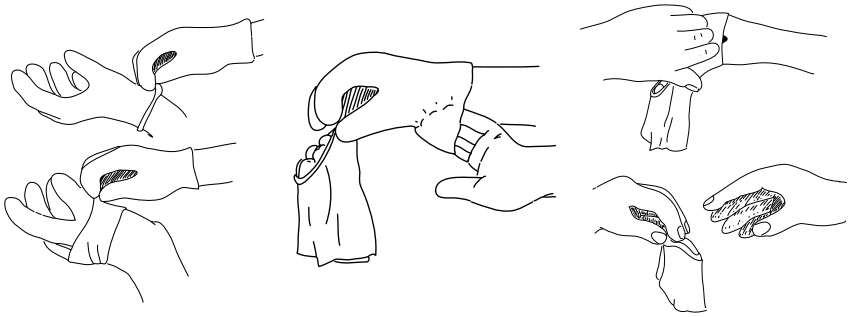


5. Protect your body with adequate clothing: Wear enough clothing so that your skin is not exposed to contaminated tissues and blood. During some disease investigations, disposable plastic uniforms or aprons that are worn over your normal clothing may be available.

Collectively, these items to protect a person from disease exposure are called **"Personal Protective Equipment" or "PPE."**

What should you do when you have finished working?

After assisting with examination and sampling of live animals or a carcass, remove dirty clothing and supplies like masks, glasses, and shoes, and remember again to wash your hands. Gloves must be worn during all steps of protective equipment removal and washing/disinfecting of gear. When removing gloves, reverse the glove as it comes off the hand so that the "dirty" material is on the inside of the glove and your bare hand is only touching the "clean" side of the glove.



Washing contaminated clothing and objects:

When washing objects and clothes that might be contaminated with a pathogen, make sure to use soap, and make sure that the person doing the washing is wearing gloves and does not have any cuts or sores on his or her arms and hands. Do not wash contaminated clothes or objects in rivers and streams; instead, use a wash basin and dispose of the dirty wash water into a safe area away from water sources used by animals and humans.

Disposal or incineration of disposable items:

Contaminated disposable objects like gloves, masks, and any tools used in sampling should be placed into sealable plastic bags or containers and either transported to a designated facility authorized to dispose of medical waste, or be incinerated on-site.

Disinfection of non-disposable items:

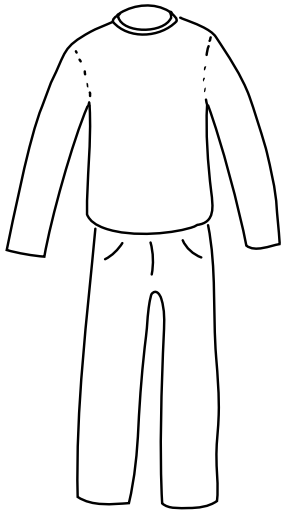
Contaminated non-disposable objects like protective glasses, face shields, clothing and re-usable tools should be disinfected after each use. Sodium hypochlorite (bleach) can be used to disinfect non-clothing items, while boiled water should be used for disinfecting clothing. To prepare a bleach disinfectant solution, make a 1-to-5 dilution of bleach with water (1 part bleach in 4 parts water) and put the solution in a basin to wash the objects. Dilute bleach solution is corrosive, so after washing the objects in the solution, rinse the items thoroughly with water. Further disinfect tools and instruments in ethanol after disinfecting with bleach and water. Bleach is toxic when ingested by animals and people and may still contain some pathogen, so make sure to dispose of it in a safe place away from water sources used by humans and animals. DO NOT pour used bleach solution into a river or stream. Always dilute bleach with water – bleach can cause skin burns and eye irritation if used without dilution. If you get bleach in your eyes or on your skin, flush the affected area with large amounts of water.

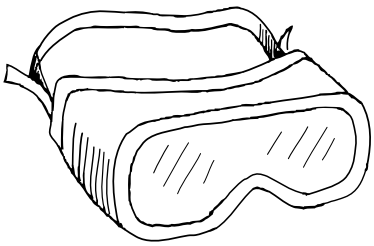
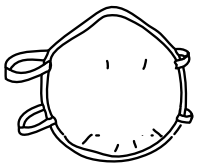
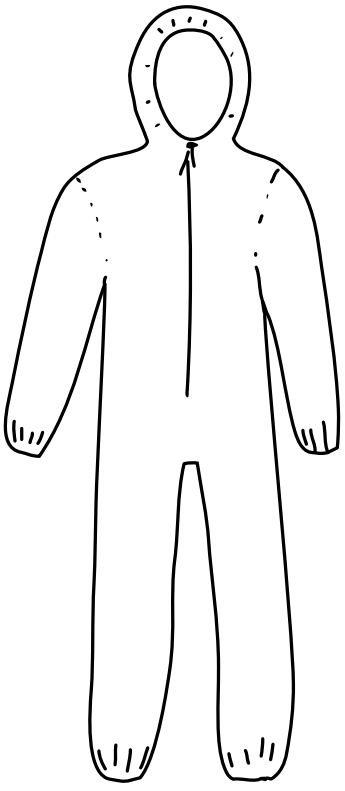
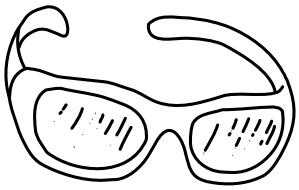
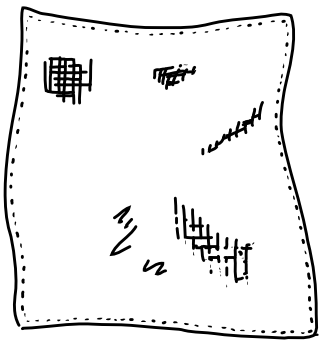
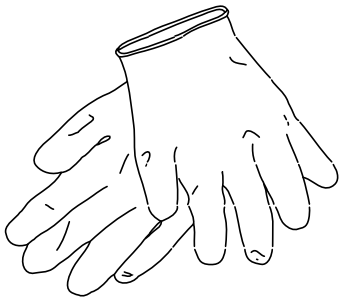
Matching Exercise: Staying safe when working with animals

How do you protect yourself when working with animals?

Draw a line from each item to the appropriate body part that the item is supposed to protect. Mark "BEST" or "BASIC" next to each item to indicate the level of protection from disease provided by each item.

Eyes **Foot** **Body** **Nose/Mouth** **Hands**



Section 2. Safe Necropsy and Sample Collection:

A necropsy is the process of examining an animal carcass and collecting samples to determine the cause of death.

In your duties, you may be called upon to assist a veterinarian or other health officer with collecting samples from live animals, or with the examination of the tissues of a dead animal.

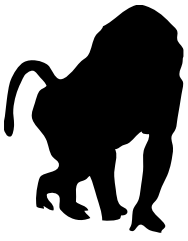
If you are assisting with a necropsy, make sure to have personal protective equipment available and wear PPE during the necropsy. It is not recommended for people without advanced training to perform a necropsy alone.

Before opening a carcass, carefully assess the environment and observe the condition of the carcass without touching it. If there is a camera available, take a picture of the carcass and the surrounding area.

Note the following:

- The nutritional condition of the carcass (is it thin, ideal?).
- Whether or not the carcass is severely decomposed. If the carcass is too rotten it is not worth conducting a necropsy; fresh carcasses are best.
- Was the animal predated or scavenged? If the animal was predated upon before death any bite wounds will have bruising and blood present. If the animal was scavenged after death, the bites will not have bruising or blood. Look for signs of struggle on the ground or on the carcass (scratches, hair loss, small wounds) that could indicate predation.
- Is the carcass near a water source? Are their multiple animals dead near a water source? Deaths near the water could indicate a toxin or anthrax is present.

Take additional precautions if certain species are found dead or certain diseases are suspect:

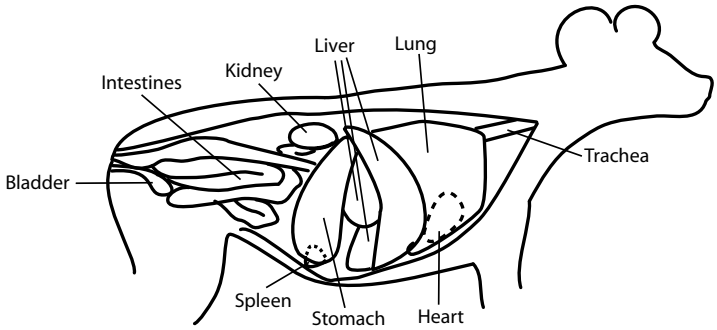


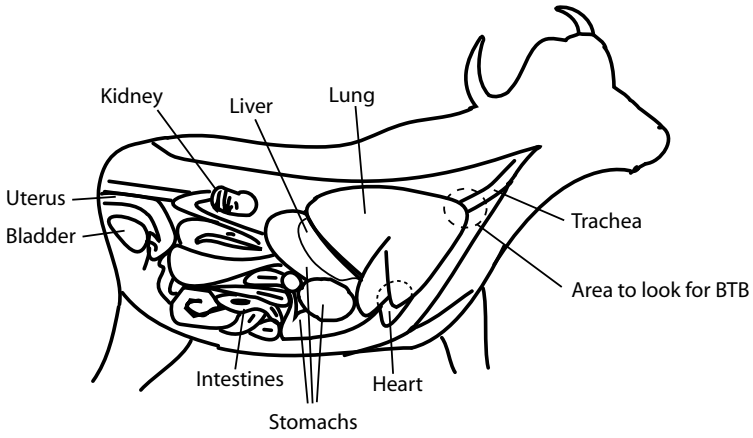
- **Primates**: Be VERY cautious when working with primates. Primates can be infected with many diseases that will cause severe illness and death in people. DO NOT conduct a necropsy on a primate if you do not have a full set of PPE available (gloves, masks, eye protection, protective clothing).
- **Anthrax**: If there is blood draining from the mouth, ears, nose or rectum or any bloating of the abdomen (ruminants) or the head (carnivores) just record your observations and immediately notify a veterinarian or health officer. DO NOT open the

carcass of any animal suspected of dying of anthrax; opening it will release the bacteria into the environment and endanger your health.

- **Rabies**: Do not directly handle brain tissue or contact the saliva of a dead carnivore or bat without full PPE. Eye protection, a mask and gloves should be worn if handling the brain of an animal suspected to be rabid. One can obtain a brain sample by pushing a straw into the brain through the intraoccipital foramen. This allows a person to collect a brain sample without directly handing the rabies-infected brain tissue.

Overview of a necropsy



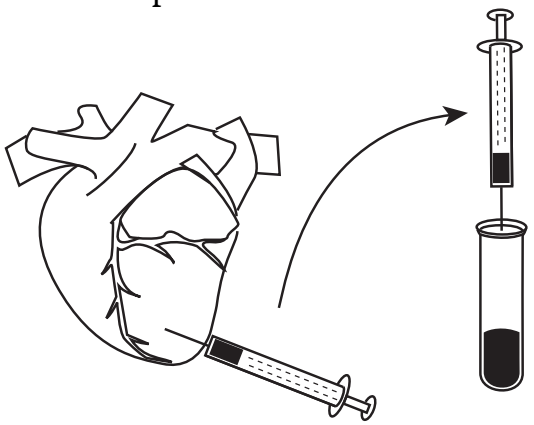


All carnivores and ungulates are placed ON THE LEFT SIDE so that the right side of the carcass is opened (see diagrams). All birds, reptiles, and primates are placed ON THEIR BACK.

After the body cavities are opened, **assess the nutritional condition of the animal**. Is there fat present under the skin, in the abdomen, near the kidney or near the heart? Write down the locations and amount (none, little, normal, or excessive) of fat observed.

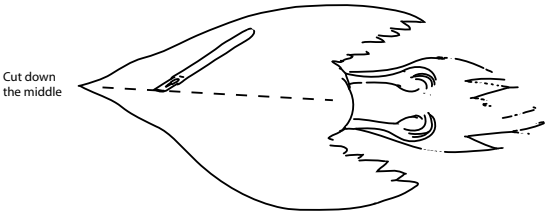
Look at the location and size of all the major organs before removing any for sampling. Do any of the organs appear enlarged? Are any in the wrong location? If so, this could be due to another organ being too large or a mass of diseased tissue. This is a good time to take a few photographs of the opened carcass. **Be sure to take a picture of any organ or body area that seems abnormal.** The normal location and size of the major organs in an ungulate, carnivore, and bird are shown in the diagrams.

At this time, a blood sample can be removed from the heart using a syringe. Also if the veterinarian wants to take sterile samples of other organs, they should be taken before any organs are handled and removed.

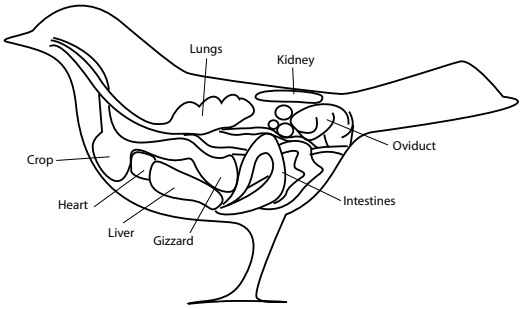


Take blood sample from the heart and place it in a blood tube

Next, the veterinarian will remove individual organs for examination, and sample collection. It is very important to record and photograph any abnormal findings, which are called **lesions.**



For example, animals that have bovine tuberculosis often have white-yellow masses present in the chest, in the lungs, in the lymph nodes or along the gastrointestinal tract. **If lesions suggestive of tuberculosis are observed, immediately protect your eyes, nose and mouth by using glasses and a mask in addition to wearing gloves.**



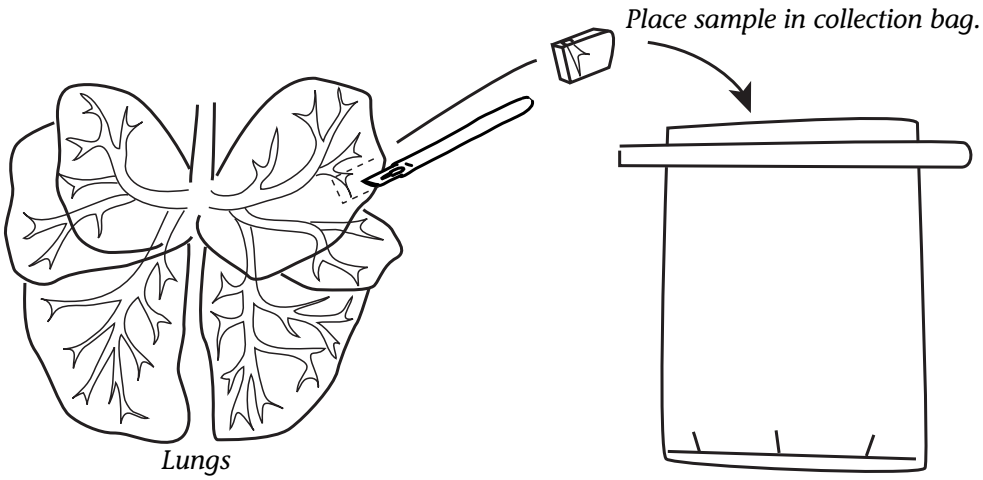
Record the color, size, shape, location (which organ or tissue) and number of any lesions. Be sure to photograph any lesions, as this will provide the best documentation for records.

Note: Some diseases do not cause abnormalities that can be seen by the naked eye during a necropsy. For example, rabies does not cause the brain to look abnormal, but the animal is still sick and a person can still contract rabies from handling the brain without protection.

Sample collection and submission:

The following basic set of samples should be collected from each animal when conducting a necropsy:

- lung
- heart
- liver
- kidney
- spleen
- muscle
- reproductive tissue
- small intestine
- large intestine
- brain (when possible)



Lungs

When examining an animal, **the veterinarian will take samples from tissues that appear abnormal**. Samples do not need to be large; in fact a small amount of tissue about the size of a bean (200mg) is large enough for veterinarians to use for laboratory disease testing.

Tissue samples should be placed it in a sealable zip-lock bag or whirlpack. Each sample should be placed in its own individual sealable bag if possible. Keep the samples cold; a cooler with ice packs is ideal if you have the resources. At a minimum, samples should be kept out of direct sunlight, and protected from scavenging by insects and animals when in the field. Samples should be transported as soon as possible to a veterinary office so that they can be properly stored. If preserving solutions like formalin or viral transport media are available, each sample should be placed in a sealable container containing the solution. Each veterinarian will have their own specific instructions for taking samples, so make sure to consult your wildlife health professionals about sample selection, sample numbers, and appropriate storage conditions before collecting samples.

The Appendix provides more detailed sampling guidelines for necropsies.

Disinfecting the necropsy site

After a necropsy, it will be necessary to disinfect the site. Field disposal may be the best and safest option for disposal of carcasses and waste generated during the necropsy procedure, because moving potentially infectious material may add to the risk of spreading disease to other areas.

For field disposal, the carcass and all tissues from the carcass including blood soaked dirt should be buried or incinerated. The best option for carcass disposal may be burning and burial, burial only, or just leaving the carcass where it is found. If you are alone and come upon carcasses in the field, report the event and carcass location to your local veterinarian. DO NOT attempt to dispose of the carcass yourself, unless you are prepared with appropriate personal protective equipment and the materials and resources for disposal and site disinfection.

All contaminated paper or plastic materials should be thoroughly disinfected or incinerated. Burying waste contained in plastic bags without burning may allow pathogens to survive longer, posing greater risk to people and animals. All blood and residual tissues should be removed from instruments and tools with soap and water. Then the instruments should be disinfected with ethanol or isopropyl alcohol. Necropsy boots and apron should be cleaned and any contaminated clothing thoroughly washed. The external surfaces of any containers with samples should be washed.

How do I know when to burn or bury infectious waste in the field? Field disposal of infectious waste is best when the amount of waste cannot be safely placed in sealable containers like buckets and transported to a health facility for disposal. Also, field disposal is appropriate when transport of the waste may risk spreading the infection to other areas or if the vehicle or means of transport does not have enough space to safely store the sealed waste containers.

Before choosing field disposal, make sure there is a safe place to burn and bury the waste. This place must be at least 50 meters from a water source, away from people and their houses, cropping areas, and livestock grazing areas, and where groundwater is at least 1.5 meters below the bottom of your newly dug waste burial pit. Make sure to choose a site with soil that is easy to dig and that is flat. Also, make sure that you have enough material on hand to start a fire for burning the material in a field incinerator, or in a burning pit. Finally, make sure that there is not a risk of the burning pit causing a brush fire.

Section 3. How to Report Disease Events

What do you do if you identify a disease event or outbreak?
Your role as a ranger or scout puts you in a position to identify disease events and outbreaks before they are recognized by other professionals like wildlife biologists, ecologists, veterinarians, and park wardens. It is your responsibility to ensure that these professionals are informed of any potential disease events in wildlife, livestock, or domestic animals in surrounding areas. This section will help you organize the information you have available for effective reporting to the appropriate professionals and authorities.

The Appendix has a disease event reporting form you can use or tailor to the area in which you work. Please make sure to check with your local veterinarians and authorities before using this form, as they may already have their own protocols used to record disease events and outbreaks.

Who do you report to in your area?

_____

Steps to Investigate a Disease Event

Step 1: Be safe! Characterize the disease event: do you need to put on your protective equipment before starting to observe the scene? If yes, put on the equipment first, and then approach the animal or carcass(es).

Step 2: Observe the animal or carcass for signs of disease. Was the animal killed by a predator/hunter or disease? Are there signs of bleeding? How long has the animal been dead?

Step 3: Record your observations on a disease event report form or in your notebook. Record the date, time, location of the event, your name, and all observations about the animal, carcass, and surroundings. Think like a detective at a crime scene! Are there signs of scavenging? Are there other animals dead nearby? Take pictures if you have a camera, and record your location on a GPS if you have one.

Step 4: Are you specially trained to take specimens? If no, then proceed to Step 6. If you have been trained and authorized to conduct necropsies and collect samples from animals, including how to protect yourself with appropriate gear during sample collection, then proceed with sampling. Remember, you should already be wearing your protective equipment, so you may take out your sampling gear and take all necessary samples (See Section 2 above for instructions on sampling).

Step 5: Make sure all your samples are labeled appropriately (see Section 2 above), and stored in leak-proof/break-proof containers in ice coolers if necessary.

Step 6: Cover the carcass with vegetation to prevent other wildlife from potential exposure through scavenging, or from environmental contamination from flies and other vectors.

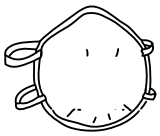
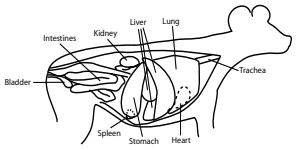
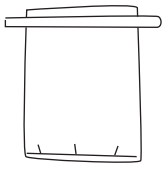
Step 7: Report the disease event to the relevant authorities. Each area should have its own reporting system that may rely on cell phones, or personal reporting to headquarters or the ranger station. If you have a cell phone, call or send a text message to other scouts or the ranger station immediately to report the event.

Step 8: Submit your disease event report to the relevant authorities. This report will act as the first responder report, and will help the local veterinarians, district game officers, ecologists and wardens to characterize the event, determine a cause, and design prevention and control options.

Section 4. Supplies and Resources for Working with Animals

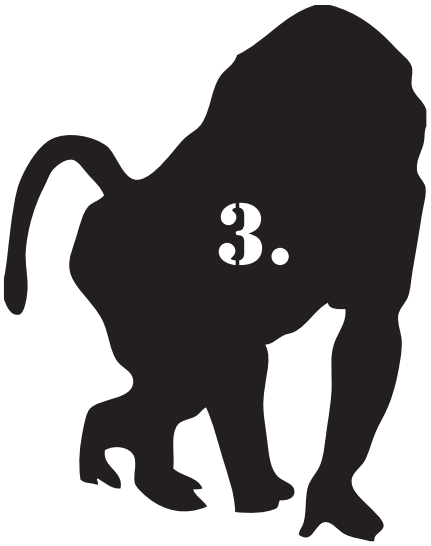
As a scout or ranger there are other tools you need besides your expert knowledge. Recommendations for supplies and resources that rangers and stations should have for animal field-handling tasks are shown below. A more detailed supply checklist is provided in the Appendix.

Recommended Minimum PPE for Animal Handling Tasks:

Animal/Task	Gloves 	Mask or N95 Respirator* 	Face Shield or Protective Glasses 	PPE Coveralls or Dedicated Clothing with Washable Shoes 
Animal handling (Live or routine necropsy)** 	Required	Recommended if in close contact with the animal during sampling; required for primates	Recommended for those in close contact with the animal during sampling activity	Required (either coveralls or dedicated clothing)
Necropsy of sick animals 	Required	Required	Required	Required (either coveralls or dedicated clothing) with apron*
Collection of animal feces or urine from the environment 	Required	Recommended	Recommended	Recommended

**If available.*

***When handling live animals that pose a bite or scratch risk, it is recommended that leather gloves be worn over nitrile or latex gloves for added protection. Nitrile gloves are more puncture resistant than latex and may reduce the risk of exposure from a bite or scratch better than latex.*



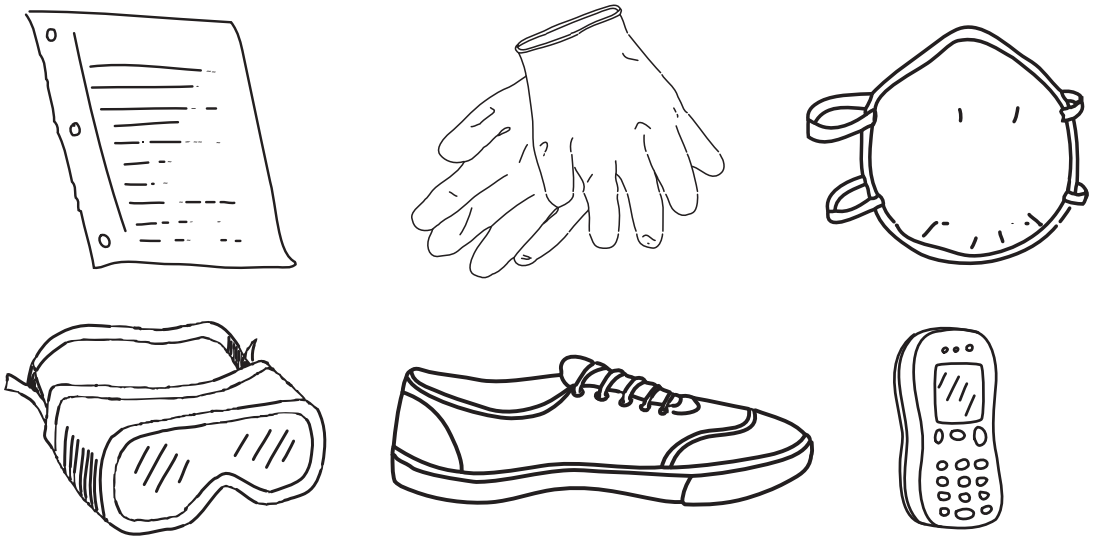
Are you a wildlife health expert?

Practical Exercises

These practical case scenarios will help you apply what you learned in this handbook. Instructions are provided for each step, and an answer key is presented at the end of each exercise.

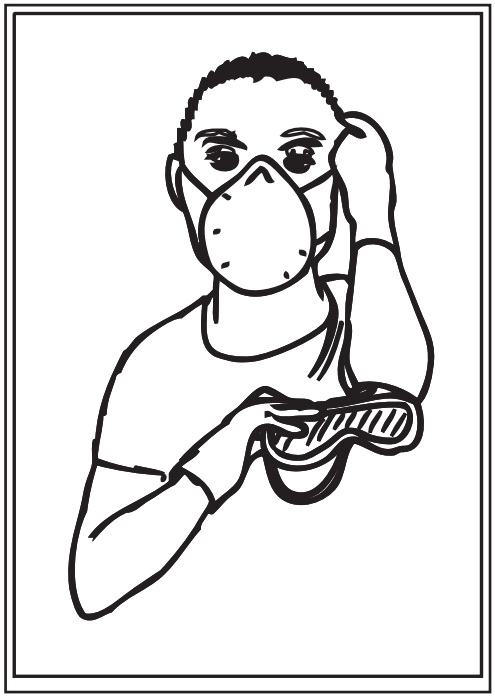
Exercise 1. A Disease Event in the Wildlife Management Area

1) Bwana Afya is at the scout station preparing to go into the field. **What supplies should he take along with him?** Circle the items he should take.



After choosing his field kit, Bw. Afya rides into the wildlife management area on his bicycle. He sees birds circling in the sky overhead. Using binoculars, he identifies the birds as vultures. He rides closer to see what they are circling.

2) Upon arriving at the area where the vultures are, Bw. Afya sees two animal carcasses on the ground near a small water hole. **What should he do next?**



A: Put on basic PPE before approaching the carcasses.

B: Go directly to the carcasses to take a picture.

Bw. Afya then approaches the carcasses for closer inspection. He identifies the two carcasses as buffalo. He thinks to himself that the carcasses are fresh. Aside from the vultures that were beginning to scavenge the buffalo when he arrived, there are no signs of predation or poaching.

3) Bw. Afya has read the HALI Health Handbook and thinks that this might be a **disease event.** He then observes blood leaking from the nose and mouth of the buffalo. **If you were Bwana Afya, what would you do?** Check all that apply.

□ A. Take out your notebook or field data sheet and record your observations.

□ B. Get your camera and take a few pictures of the carcasses.

□ C. Use your cell phone and try to notify the local veterinarian or game officer.

□ D. Open the carcass to look inside the body.

Bwana Afya records his observations in his notebook and takes a few pictures. He tries to call the local veterinary officer and game officer, but has no cellular network. He thinks about the symptoms of the animals, and then thinks to himself "what disease might have caused the deaths of these buffalo?"

4) Can you help Bwana Afya identify possible causes of the disease event?

Write your ideas here.

5) After thinking about the disease and about his own safety, **Bwana Afya needs to come up with a plan of action.** Circle "yes" or "no" after the following questions.

A. Should Bw. Afya take samples and perform a field necropsy right away?

Yes No

B. Should Bw. Afya cover the carcasses with vegetation or a canvas cloth and report back to the scout station?

Yes No

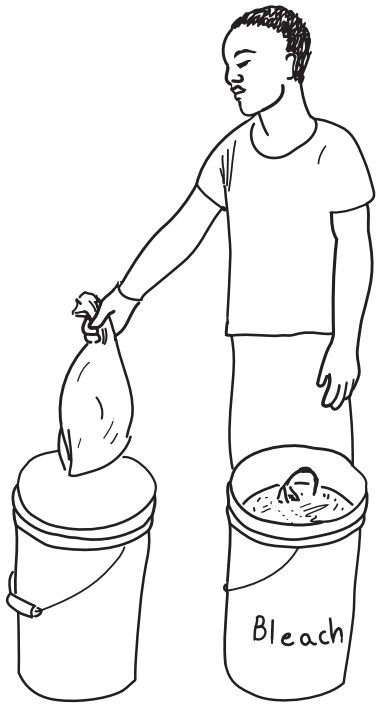
C. Should Bw. Afya burn the carcasses?

Yes No

6) Bw. Afya returns to the scout station to report his findings to the lead scout and local authorities. **Before traveling back to the station to report, what important step should he remember?** Circle the correct action.

A. Stop at the market to pick up food for dinner.

B. Watch for predators on his way back.

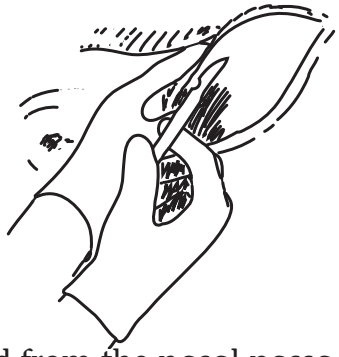


C. Remove PPE, disinfect non-disposable PPE, and place all infectious material into a sealable container for incineration.

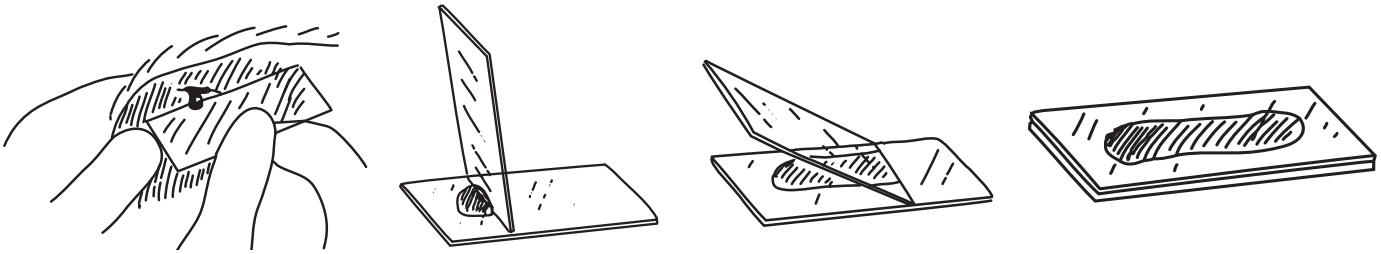
Because Bwana Afya covered the carcasses, he minimized the risk of spreading a pathogen to scavenging wildlife, other animals, and people.

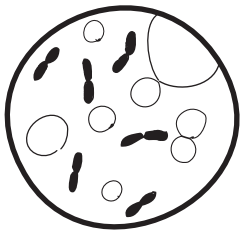
After arriving at the scout station, Bw. Afya reports his findings, hands over his notebook, and shows the pictures to the lead scout and local veterinarian. The veterinarian decides to visit the field site where the carcasses are and chooses Bw. Afya to take him there and help perform a **field necropsy.** They take the full field necropsy and safety kits, and begin to work on the covered carcasses.

The veterinarian suspects a zoonotic disease based on Bw. Afya's report, so before cutting the carcass open, he cuts a small vein on the animal's ear to collect blood.



The veterinarian then swabs some of the blood from the nasal passages and smears the blood onto microscope slides. The slides are air-dried then immersed in alcohol for a minute.





After they have dried, he looks at the slides in his field microscope and sees many rectangular shaped bacteria forming long chains in the sample. He tells Bw. Afya that his instincts were correct; it is an outbreak of anthrax!

7) What should the veterinarian and Bwana Afya do now? Check all that apply.

□ A. Dispose of the carcasses by burying them.

□ B. Dispose of the carcasses by burning them.

□ C. Slow the spread of the disease by doing some controlled burning of the brush and vegetation surrounding the carcasses.

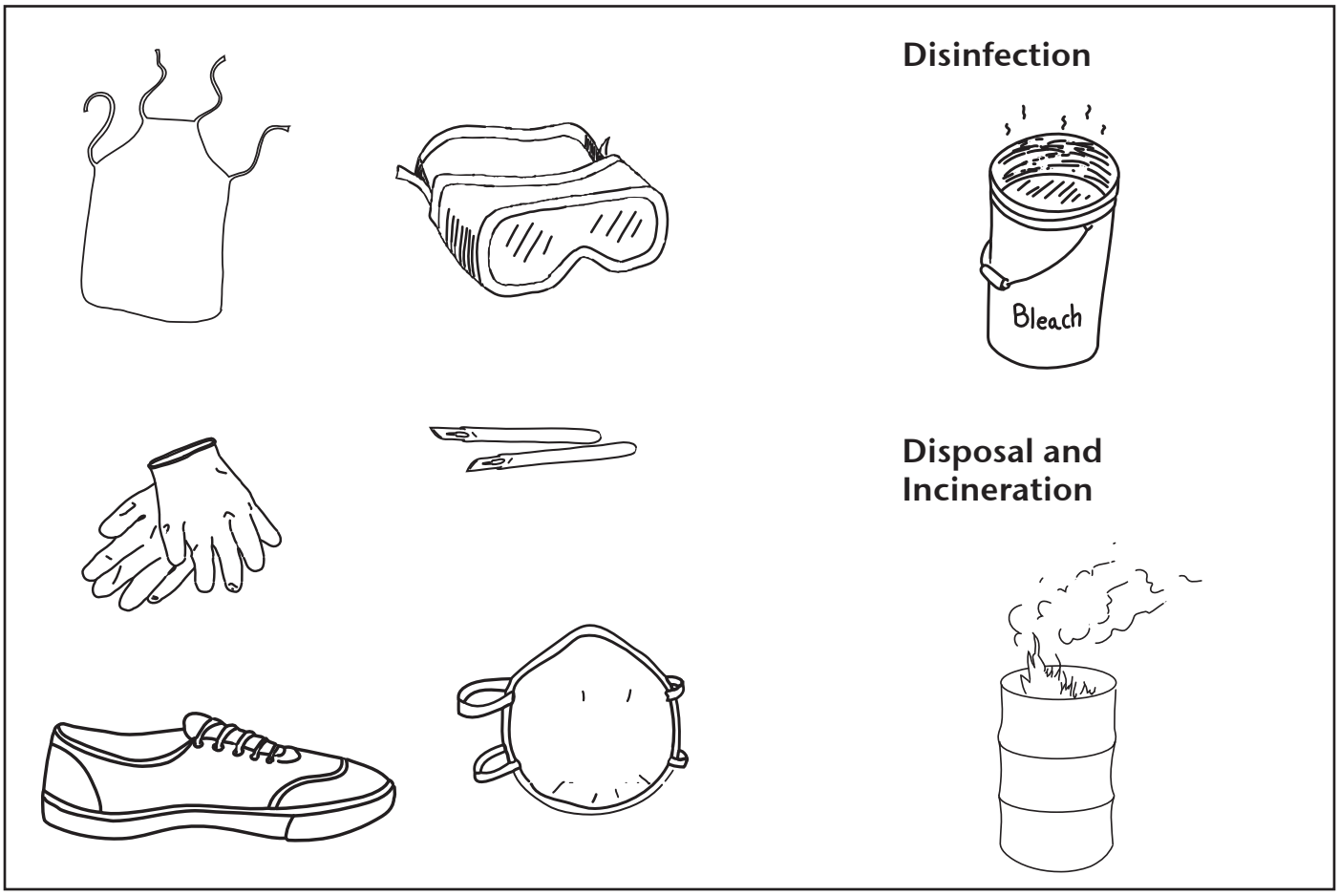
□ D. Contact the scouts, game officers, and wildlife management area ecologists to conduct investigations looking for other die-offs in the area.

□ E. Advise local authorities and the local livestock office to investigate any other die-offs and begin thinking about vaccination plans.

□ F. Notify all authorities about the outbreak and potential hazards so a plan of action can be established.

When they have finished with the field necropsy and carcass disposal, the field veterinarian and Bw. Afya disinfect and decontaminate their PPE and necropsy equipment so they can return safely to the station.

8) What items should the veterinarian and Bw. Afya disinfect with bleach, and what items should they discard through field incineration? Draw a line from the item on the left to the appropriate method of disinfection or disposal on the right.



Even though Bw. Afya and the veterinarian were careful to be safe in the field, the veterinarian tells Bw. Afya to report if he develops any illness or swelling of lymph nodes, or if he notices any cuts or scratches that become inflamed with small blisters or swelling. **Anthrax can be successfully treated with antibiotics if the signs of infection are noticed and treatment is started quickly.** After a long day, Bw. Afya and the veterinarian return to the station to file their necropsy and carcass disposal reports, and to begin informing the local livestock and public health authorities about the anthrax outbreak.

Is there anything you would have done differently than Bwana Afya in this situation?

This scenario was very specific to Bwana Afya's scout station and wildlife management area. Are there any differences in procedure in the area where you work in outbreak investigation and reporting?

_____

_____

_____

About this Exercise

Anthrax is a disease caused by the bacterium *Bacillus anthracis.* Anthrax affects both humans and animals. Anthrax is often fatal if not treated.

Anthrax bacteria is spread through spores, which can survive harsh conditions and stay in the soil for many years.

When spores are inhaled or in contact with skin they can cause disease in animals and people. Anthrax is very common in ungulates like buffalo and cattle which can ingest spores when grazing. Carnivores and humans can also become infected by feeding on infected animals.

Prevent anthrax by minimizing contact with the spores. As a best practice, burning all clothing and articles that may have contacted the spores is very effective. Although disposable aprons and PPE are recommended, protective clothing and objects that cannot be burned should be soaked in bleach or formalin for at least 12 hours. CAUTION: both bleach and formalin are toxic and caustic to skin, eyes and nose so PPE must be worn when working with these chemicals. Signs of anthrax infection due to skin exposure in people include painless blisters and boil-like skin lesions that can form a black centered sore or ulcer.

Early treatment with antibiotics is the only way to eliminate the infection. If a person inhales anthrax it is especially deadly, so masks must be worn at all times. If you suspect anthrax inhalation, you must immediately go to a clinic for treatment to prevent possible death.

Answer Key – 1) All items should be taken. 2) A. 3) A, B, and C – Inspecting the carcass should not be done without a veterinarian or a veterinarian's instruction. 4) Anthrax causes bleeding from the mouth and nose. Some viral diseases also cause bleeding. 5) A-No, B-Yes, Bw. Afya should cover the carcass and report to the station. He should try not to disturb or move the vegetation close to the carcass because this can cause anthrax bacteria spores to enter the air and spread. C-No. He should wait until instructed by a veterinarian. 6) C-Always remove and disinfect your PPE before interacting with other animals and people to prevent disease spread. 7) B, C, D, E, F. Only burying the carcass may still spread disease to other animals if scavengers dig up and consume the carcass. 8) Protective glasses, shoes = disinfection; Apron, scalpel, gloves, mask – disposal and incineration.

Exercise 2. Danger at the Safari Lodge

Bwana Mzuri is a ranger stationed at the National Park headquarters. While on duty he receives a call from the manager of a safari lodge located at the park border about 20 km from headquarters. The manager tells Bw. Mzuri that they need help immediately because there is a hyena wandering through the lodge area during the daytime. The manager says that the animal is not afraid of people and will not leave despite the employees yelling at it and banging pots and pans.

1) Bw. Mzuri decides to respond to the manager's call for help, but he knows that it will take about an hour to prepare and drive to the lodge. **What should Bw. Mzuri tell the manager to do while they wait for help?** Check all that apply.

□ A. Get some machetes and take a few staff members and chase the hyena out of camp.

□ B. Try to get the hyena's attention by yelling at it.

□ C. Order guests and staff to stay indoors and close windows for their safety.

□ D. Tell the manager to grab the nearest firearm and shoot the hyena in the head.

□ E. Tell the manager to not provoke the animal, and just monitor it from a safe distance inside a building.

2) **Bw. Mzuri is packing his supplies to respond to the situation. What should he do as he prepares to leave?** (Circle all that apply.)

A. Go eat lunch first. There is no reason to hurry; the hyena will either still be around the lodge or will have moved on.

B. Alert the park veterinarian and ecologist about the situation, and if possible bring one of these staff members along.

C. Bring the PPE kit.

D. Bring a human first aid kit.

E. Pack a functional firearm and plenty of ammunition and ensure that at least one other ranger or staff member experienced in using firearms can come with him.

3) Bw. Mzuri, a second ranger, and a driver leave for the safari lodge. While they are driving, **Bw. Mzuri is thinking about possible reasons why this hyena is behaving so strangely**. Circle all the reasons below why the hyena might be behaving abnormally:

A. The hyena is starving and seeking food at the lodge.

B. The hyena is sick.

C. The hyena is protecting a baby.

D. The hyena is lonely.

4) Because Bw. Mzuri has received wildlife disease training, he knows that t**here are two diseases that could be causing the strange behavior of this hyena. Can you name both of these diseases?**

1. _____

2. _____

Which one of these diseases is zoonotic (can be transmitted from animals to people)?

_____

5) When Bw. Mzuri arrives at the lodge, they observe the hyena wandering and circling in an area outside the kitchen. The hyena looks disoriented and has saliva dripping from its mouth. **Bw. Mzuri strongly suspects the animal is rabid. What should he do next?** Check all that apply.

□ A. Quickly jump out of the car and shoot the hyena in the head.

□ B. Stay in the car and shoot the hyena in the head.

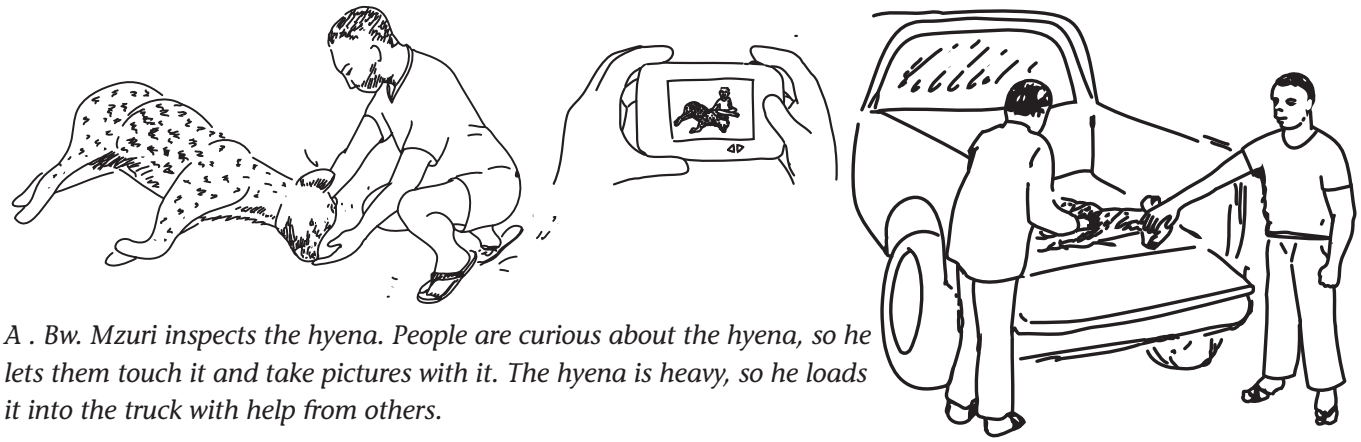
□ C. Before shooting the hyena make sure that all guests and staff are safely indoors and away from the path of any potential gunfire.

□ D. Get another vehicle from the lodge if available for the second ranger with a firearm.

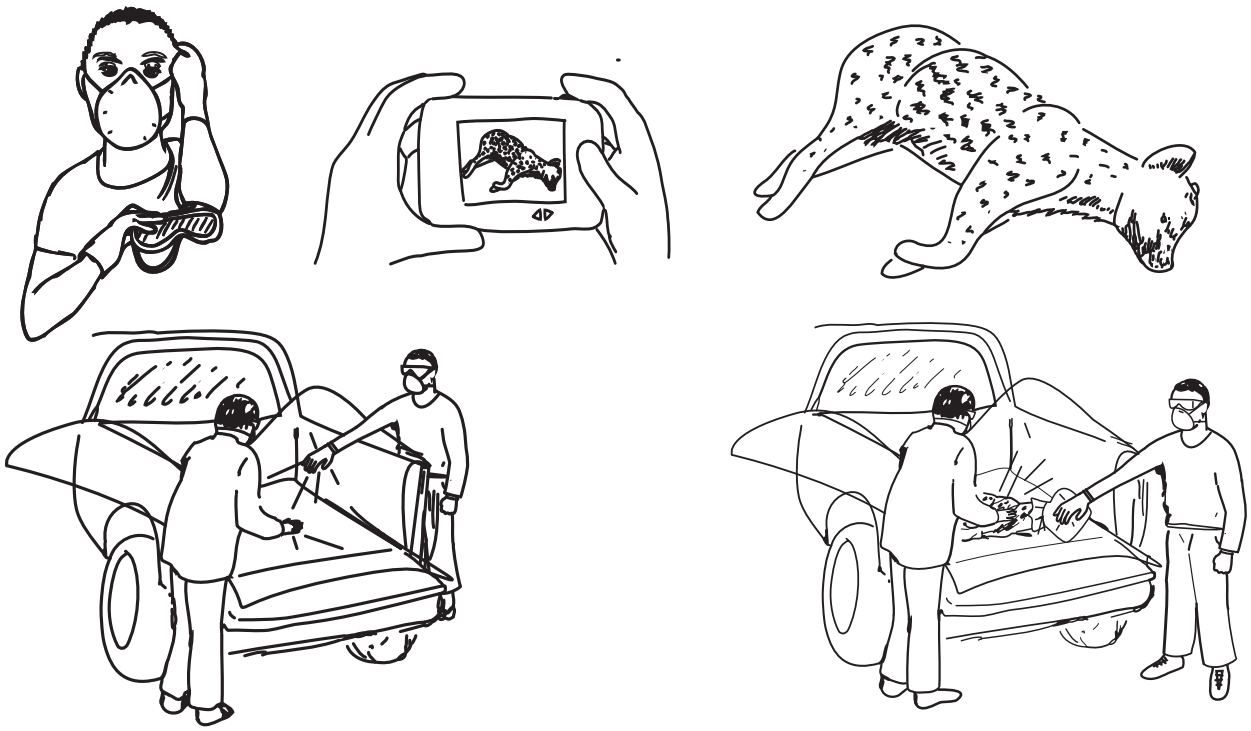
□ E. Get one or both cars in position to make a clear shot at the animal.

□ F. Shoot the animal in the heart so the brain is preserved for disease testing.

6) **Bw. Mzuri successfully shoots the hyena in the chest.** He waits in the car until he is reasonably sure the hyena is dead, then drives towards the carcass. While still in the car he pokes the hyena with a sharp stick to make sure the animal is dead. **The park veterinarian requested they bring the animal back to headquarters for a necropsy. How should Bw. Mzuri proceed?** Circle the right set of actions from the two options below:



A . Bw. Mzuri inspects the hyena. People are curious about the hyena, so he lets them touch it and take pictures with it. The hyena is heavy, so he loads it into the truck with help from others.



B. Bw. Mzuri puts on PPE to protect himself before approaching the hyena. He photographs the animal before handling the carcass. He first places a plastic bag over the head of the hyena to avoid having saliva from the hyena accidentally contact anyone handling the carcass. He covers the truck bed with plastic or a disposable sheet. He provides PPE to others so they can safely load the animal into the truck bed. The rangers and driver properly remove their PPE into a bag then a bucket before leaving.

7) **Before Bw. Mzuri leaves the safari lodge what additional advice should he give the manager?** Check all that apply.

□ A. None, the problem has been taken care of and they can resume normal business.

□ B. Thank the manager for quickly reporting the problem.

□ C. Talk to the manager and staff about recognizing the signs of rabies, and make sure to let them know that they could contract rabies if they are bitten by a rabid animal.

□ D. Have the manager and staff keep watching for additional sick carnivores, and report any new sightings.

□ E. Confirm that no other animals have been observed, and confirm that no staff had contact with the hyena prior to its death.

8) The manager thanks the rangers, and mentions that **one of his staff got bitten on her hand by a jackal yesterday while doing laundry.** Another person was able to scare the jackal away and they have not seen it since. The bite was minor so they did not send her to the hospital. **Bw. Mzuri is concerned about this report. What actions should he recommend?** Check all that apply.

□ A. Wash the bite wound immediately with soap and water.

□ B. She visit a village healer so that a poultice can be placed on the wound.

□ C. She watch the bite for signs of infection. If it looks worse in 4 or 5 days then she should see a doctor.

□ D. She immediately be transported to the regional hospital to receive rabies post-exposure vaccinations. The jackal was behaving abnormally, and she is at serious risk for rabies infection. ***Rabies is almost always fatal for people*** *so there is no time to delay. The sooner she receives the injections, the more likely she will survive.*

□ E. That this incident be reported immediately to local veterinary and public health authorities.

9) The park veterinarian conducts a necropsy on the hyena carcass and sends the brain to the university laboratory for rabies testing. **The results are positive – the hyena was rabid. What additional steps should Bw. Mzuri and the park veterinarian take?** Check all that apply.

□ A. Inform the local veterinary and public health authorities about the positive test result.

□ B. Make sure that health officers and village government officials in the villages neighboring the park are aware that a rabid animal has been detected near the park border.

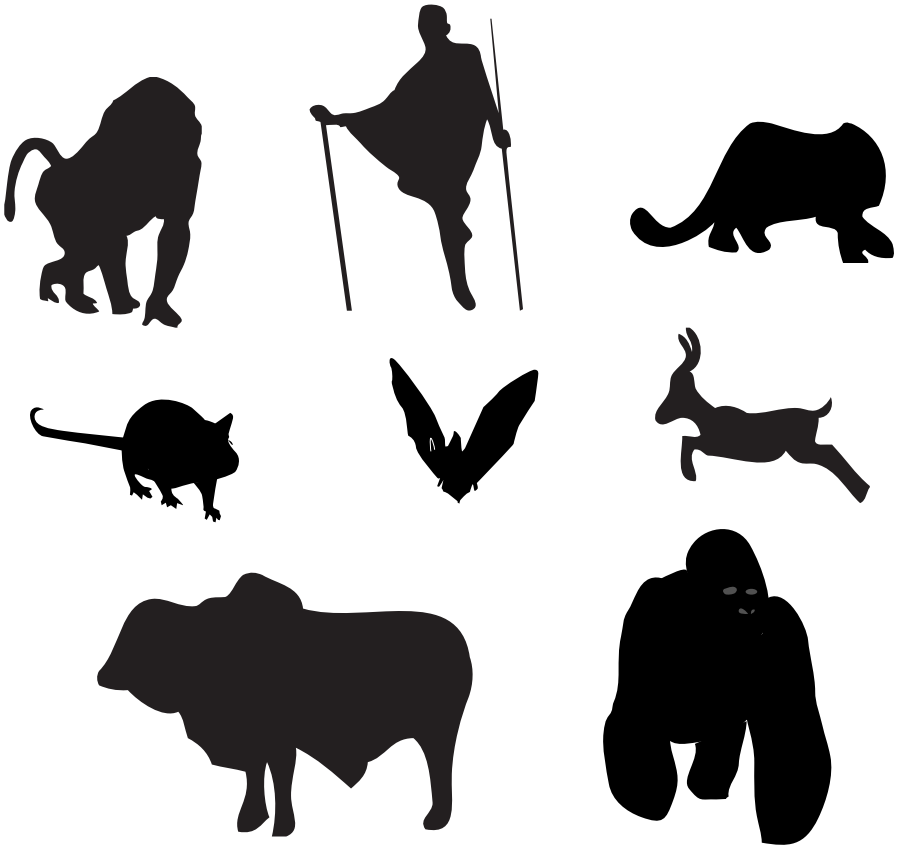
□ C. Nothing, the case is closed.

□ D. Make another call or visit to the safari lodge to make sure the women bitten by the jackal was taken to the hospital and received post-exposure vaccination.

□ E. Alert all the ranger posts within the park so that rangers can be watching for additional cases.

□ F. Whenever possible, work with local veterinary authorities to conduct a rabies vaccination effort for domestic dogs in villages bordering the park.

10) **Which species pictured below can be infected with rabies?** Circle all that apply.



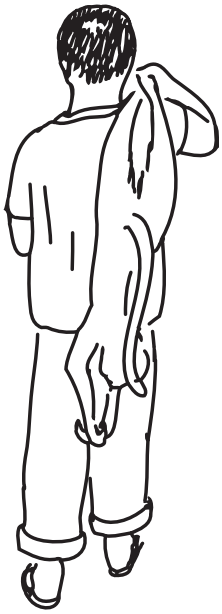
About this Exercise:

Rabies is a deadly viral infection that is mainly spread from animal-to-animal or animal-to-person by a bite. Any species of warm-blooded animal can be infected. Domestic dogs and cats, wild carnivores, and bats are the most commonly infected animals. Rabies has been responsible for the deaths of entire packs of African wild dogs. Jackals, genets, bat-eared foxes, and mongoose are also commonly infected. Occasionally, livestock are infected if bitten by a rabid carnivore or bat. People can also be infected.

Any person bitten by an animal suspect to be rabid must immediately go to the hospital to receive post-exposure vaccination. The bite wound should be immediately washed vigorously with soap and water. Clinical signs can take long time to appear and when they do it is too late for treatment. Therefore, it's critical that post-exposure vaccination be conducted quickly so that a person is treated before any clinical signs of disease appear.

Answer key – 1) C and E. 2) B, C, D, and E. 3) A, B, possibly C but less likely. 4) 1- Rabies and 2-Canine Distemper Virus (CDV). Both rabies and CDV can cause a carnivore to behave abnormally, but ONLY Rabies is zoonotic. CDV cannot be transmitted to humans. 5) C, D, E and F. 6) B. 7) B, C, D and E. 8) A, D and E. 9) A, B, D, E and F. 10) All species shown can contract rabies.

Exercise 3. Reported Wildlife Deaths from a Village



Bibi Amina is a Ranger for the National Park on leave in a village that borders a wildlife management area. While relaxing with friends in a pub, she overhears some men talking about their recent trip to the forest. The men tell their friends that they were surprised to find the forest so quiet this trip, because usually they see and hear a lot of sounds and calls from wildlife, especially monkeys. One of the men also mentions that he observed **three dead monkeys during his walk yesterday,** and that the carcasses were not yet disturbed by scavengers. **One of the monkeys seemed to be freshly dead, so he took the carcass home with him.**

1) Can you identify any zoonotic disease risks associated with the men's story?

_____

_____

_____

_____

As a ranger, Bi. Amina knows that it is rare to find so many dead monkeys in the forest, and **that eating bushmeat, especially primates, can be a risk for zoonotic disease transmission.** She decides to ask the men some questions to learn more about any possible zoonotic disease risks.

2) What questions should Bi. Amina ask the men? Check all that apply.

□ A. Did they notice anything strange about the monkey carcasses?

□ B. How long had the monkeys been dead?

□ C. Did they butcher the monkey themselves?

□ D. How was the monkey butchered?

□ E. How was the monkey cooked?

□ F. Was the meat shared with other people?

□ G. Other: _____?

Bi. Amina is especially interested in the dead monkeys because she heard on the local radio station Mambo FM, that **several people have fallen ill around the wildlife management area with a strange disease.** Two people have died. Three more people are sick with a fever, headache, vomiting, with some colored spots on their bodies. **Bi. Amina has been wondering if wildlife might be associated with the strange disease.**

3) What should Bi. Amina do now? Check all that apply.

□ A. Ask if the men will guide her to the area where the monkey carcasses were found.

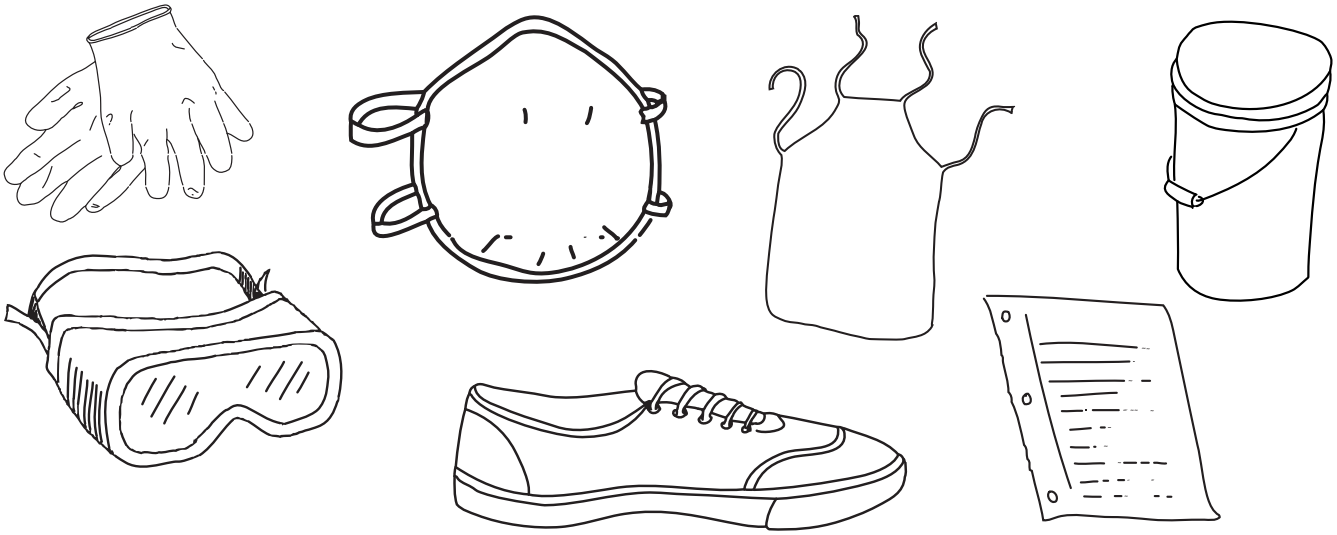
□ B. Ask if there is any meat, hide, or waste left for sampling from the monkey that was consumed.

□ C. Call her local veterinarian, district game officer, and public health authorities to report the news.

□ D. Call Mambo FM and see if she can go on the radio and become a celebrity for identifying the cause of the outbreak.

Bi. Amina calls the local veterinarian and tells him the news about the monkeys and the strange disease. Dr. Wanyama tells her he will contact the other authorities, and asks if she can work with the men to visit the location of the monkey carcasses. He explains to her the importance of protecting herself from exposure to diseases in the field and also explains some protocols to follow should she find any dead animals. He then recommends some equipment to take along from the local scout station.

4) **What protective equipment and gear should Dr. Wanyama recommend for Bi. Amina to bring with her and the men to the field?** Circle all that apply.



Bi. Amina goes to the forest with the men. **They find a freshly dead monkey carcass during their visit.**

5) **What should Bi. Amina do next?** Check all that apply.

□ A. Run home and call Mambo FM.

□ B. Take the carcass and butcher it for food since it is freshly dead.

□ C. Put on all of the recommended protective equipment.

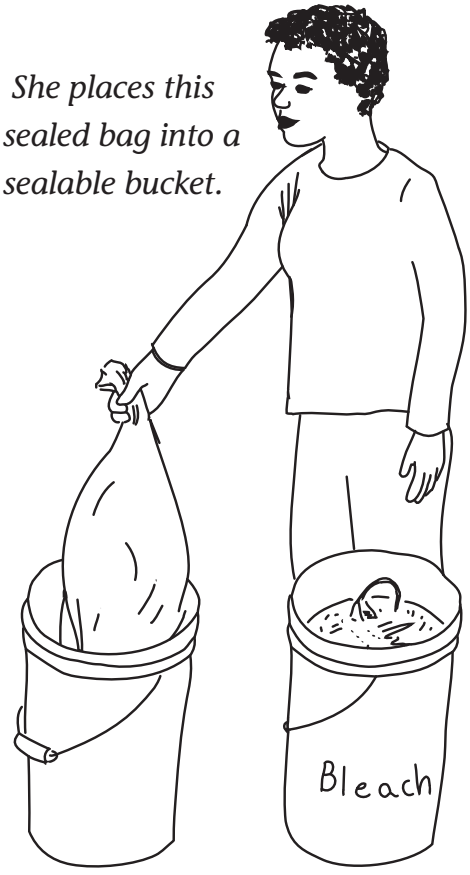
□ D. After putting on the protective equipment, carefully follow Dr. Wanyama's sampling and disinfection protocols.

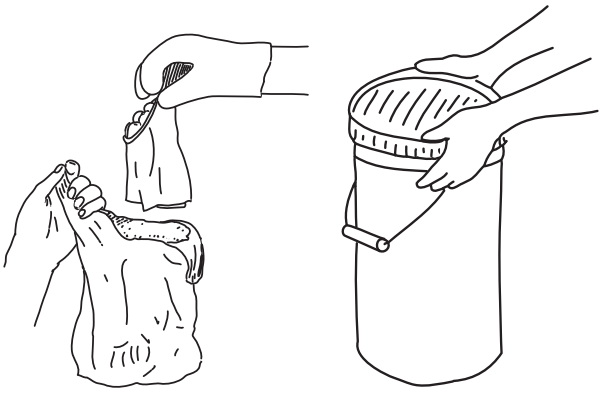
□ E. Complete the disease event reporting form.

*Bi. Amina instructs the men to **put on the protective equipment they have** brought. Before touching the animal, they take the lid off the bucket.*

Following Dr. Wanyama's sampling protocols, she carefully places the carcass into a sealable plastic bio-hazard bag.

She places this sealed bag into a sealable bucket.





She then carefully removes her protective glasses, gloves, and mask, placing them into a separate sealable biohazard bag.

She places the second sealed biohazard bag with the protective equipment into a second bucket. She and the men then disinfect their hands and seal the buckets.

After completing the disease event report form that Dr. Wanyama provided, she and the men head to town to visit Dr. Wanyama's veterinary clinic. **At the clinic, Bi. Amina again puts on protective equipment**, and opens the bucket. She carefully washes and disinfects the protective glasses, and disposes of the gloves, mask, and biohazard bag into the clinic's field incinerator. She puts the bucket with the sealed bag containing the carcass into the clinic's specimen freezer. Then she removes and disposes of the protective equipment she has worn for the clean-up, washes her hands, and tells Dr. Wanyama about the events and carcass. Dr. Wanyama is happy with the carcass recovery, and tells Bi. Amina to wait for further instructions from him and the local authorities.

Is there anything you would do differently from Bi. Amina?

_____

_____

_____

What are some of the possible zoonoses that might have caused the strange disease?

_____

_____

_____

About this Exercise:

An animal die-off could be caused by a number of pathogens, some zoonotic, and some that may be of no harm to humans. However, it is essential to protect yourself from unknown diseases, as you can never be sure what has caused the deaths. Monkeys, for example, are highly susceptible to death from viruses like Ebola and Marburg, which cause deadly bleeding and fevers in humans too. The monkeys could also have been infected with rabies, or even anthrax like in Exercises 1 and 2.

In an unknown disease or strange disease scenario, personal protection is the top priority, along with carefully disinfecting and disposing of anything that may have come into contact with the dead animals or objects that have touched the animals.

Using the 5Ps from the HALI handbook, and referring to the W.A.S.H. guidelines will help keep you safe, but knowing the risks, using your knowledge of where disease might be lurking, and what to do when you suspect disease is your most effective tool for staying healthy and protecting the health of the community and wildlife around you.

Answer Key – 1) There are many possible zoonotic disease risks, for example: Anthrax, Ebola, Marburg, or Rabies. When several animals in the same area are found dead there may be a deadly disease in the area and precaution must be taken to prevent contact with the dead animals. 2) All are great questions to ask to find out more about the dead monkeys and any contact the hunters have had with the carcasses. 3) Answers A, B, and C are appropriate, but first notifying the veterinarian or local wildlife health authority is essential. It may not be appropriate to go public with information on an animal die-off without first notifying your local veterinarian and health authorities of the situation. 4) All of the above. It is essential to wear PPE when working with primates. 5) C, D, and E.

APPENDICES

Appendix A - Key Terms

Bacteria – A large group of single-celled organisms. Bacteria are microscopic in size and are found in all of Earth's habitats. Some bacteria are pathogenic and can cause infectious disease such as anthrax, plague, tuberculosis, brucella, and leprosy.

Disease event – An occurrence of disease is animals or people that is detected and reported.

Infection – The invasion and reproduction of a pathogen in the body tissues. When infection occurs, the person is considered "infected."

Lesion – An abnormal change in a body tissue which may indicate disease.

Mite – A very small (almost invisible to the naked eye) relative of spiders and ticks with a flat, almost transparent body and four pairs of legs. Many species of mites are parasitic and cause or carry diseases that infect humans and animals.

Necropsy – A systematic process of examining an animal carcass and collecting samples to determine the cause of death.

Outbreak – When a disease makes an abnormally large number of animals or people sick in a short time or in a specific area.

Pathogen – Any living organism that causes disease. Examples include viruses, bacteria, and parasites.

Parasite – An organism that lives in or on another organism (a host) and benefits at the host's expense.

Transmission – The process of how a pathogen that causes disease spreads from animal-to-animal or animal-to-human.

Virus – A small infectious agent that can only replicate inside of a living organism's cell. Viruses are known to infect all kinds of organisms including bacteria, plants, animals, and people.

Zoonosis – A disease that can be transmitted between animals and people. Examples include rabies, anthrax, bovine tuberculosis, brucellosis, and Ebola virus.

B. Zoonotic Disease Transmission Routes

	Transmission Route	Aerosol	Oral	Direct Contact	Reproductive	Common-Source (Fomite)	Vector-borne
Bacteria	Anthrax	A	O	D		C	
	Brucella	A	O	D	R		
	Campylobacter		O				
	Chlamydia psittaci	A					
	Leprosy	A		D			V
	Leptospira		O	D			
	Plague	A		D			V
	Q fever *(Coxiella burnettii)*	A	O				
	Salmonella		O				
	Tuberculosis	A	O	D			
	Tularemia	A	O	D			V
	Typhus						V
Parasites	Cryptosporidium		O				
	Echinococcus (Hydatid disease)		O	D		C	
	Giardia		O				
	Leishmaniasis						V
	Malaria						V
	Scabies (Mange)			D		C	
	Toxoplasma		O				
	Trypanosomiaisis						V
Viruses	Crimean Congo Hemorrhagic Fever			D			V
	Dengue Fever						V
	Ebola / Marburg			D			
	Hanta	A		D			
	Herpes B			D			
	Influenza	A	O	D			
	Lassa			D			
	Monkeypox	A		D			
	Nipah	A		D			
	Rabies			D			
	Rift Valley Fever	A	O	D			V
	SARS	A					
	West Nile						V
	Yellow Fever						V

A - Aerosol
O - Oral
D - Direct Contact
R - Reproductive
C - Common Source
V - Vector-borne

Aerosol – Droplets containing pathogens that move through the air and are inhaled by animals and humans
Oral – Ingestion of pathogens from food, water, milk, or from the environment
Direct Contact – Spread of the pathogen through contact between open sores, mucous membranes, or abraded skin with an infected animal or its tissues or fluids
Reproductive – A type of direct contact with the reproductive fluids or tissues of animals
Common-Source (Fomite) – Infection with pathogens through contact with non-living objects contaminated by an animal
Vector-borne – Transfer of pathogens from an infected animal by an insect, tick, or mite

Appendix C - Guidelines for sample collection and storage

Type of sample	Number of samples	Sample storage	Ideal sample storage temperature
Large intestine	2 separate 200mg samples (see storage), and 1 cm^3 sample for histopathology	1 200mg sample in a whirlpack or cryovial 1 200mg sample in VTM* 1 cm^3 sample in Formalin	200mg whirlpack (cryovial): frozen as soon as possible 200mg VTM: frozen as soon as possible 1 cm^3 Formalin: room temperature
Small intestine	2 separate 200mg samples (see storage), and 1 cm^3 sample for histopathology	1 200mg sample in a whirlpack or cryovial 1 200mg sample in VTM 1 cm^3 sample in Formalin	200mg whirlpack (cryovial): frozen as soon as possible 200mg VTM: frozen as soon as possible 1 cm^3 Formalin: room temperature
Liver	2 separate 200mg samples (see storage), and 1 cm^3 sample for histopathology	1 200mg sample in a whirlpack or cryovial 1 200mg sample in VTM 1 cm^3 sample in Formalin	200mg whirlpack (cryovial): frozen as soon as possible 200mg VTM: frozen as soon as possible 1 cm^3 Formalin: room temperature
Lung	2 separate 200mg samples (see storage), and 1 cm^3 sample for histopathology	1 200mg sample in a whirlpack or cryovial 1 200mg sample in VTM 1 cm^3 sample in Formalin	200mg whirlpack (cryovial): frozen as soon as possible 200mg VTM: frozen as soon as possible 1 cm^3 Formalin: room temperature
Kidney	2 separate 200mg samples (see storage), and 1 cm^3 sample for histopathology	1 200mg sample in a whirlpack or cryovial 1 200mg sample in VTM 1 cm^3 sample in Formalin	200mg whirlpack (cryovial): frozen as soon as possible 200mg VTM: frozen as soon as possible 1 cm^3 Formalin: room temperature
Spleen	2 separate 200mg samples (see storage), and 1 cm3 sample for histopathology	1 200mg sample in a whirlpack or cryovial 1 200mg sample in VTM 1 cm3 sample in Formalin	200mg whirlpack (cryovial): frozen as soon as possible 200mg VTM: frozen as soon as possible 1 cm3 Formalin: room temperature
Brain *(if possible)*	2 separate 200mg samples (see storage), and 1 cm^3 sample for histopathology	1 200mg sample in a whirlpack or cryovial 1 200mg sample in VTM 1 cm^3 sample in Formalin	200mg whirlpack (cryovial): frozen as soon as possible 200mg VTM: frozen as soon as possible 1 cm^3 Formalin: room temperature

**VTM = viral transport media and would be provided by your local veterinarian.*

Note: 200mg is roughly pea-sized.

Appendix D. Scout Station and Ranger Post Supply

Supply Checklists

We realize that resources are limited and that it is likely not feasible for every person to have a complete kit, therefore we recommend a basic store of supplies be kept at each ranger post or scout station, for use by staff stationed at that location. A more extensive store of supplies could be maintained at park headquarters.

Personal Protective Equipment (PPE)

- □ Latex or non-latex gloves
- □ Rubber gloves
- □ Leather gloves
- □ Face-mask
- □ Protective glasses/face shield
- □ Disposable (Tyvek) suit or dedicated coveralls or uniform
- □ Sharp-container (for disposal of needles and other sharp instruments)
- □ Closed-toed shoes
- □ Bucket/container for wash-station
- □ Disinfectant (bleach)
- □ Rubber boots or plastic foot protectors
- □ Rubber Apron

First Aid Kit

- □ Pain relievers and swelling reducers (e.g. Panadol or aspirin)
- □ Tweezers
- □ Alcohol wipes
- □ Antiseptic hand cleaner
- □ Medical adhesive tape
- □ Sterile gauze (four inch squares are best; sanitary pads also work)
- □ Elastic bandages (bandage wrap)

- □ Several sizes of adhesive bandages
- □ Triple-antibiotic ointment
- □ Hydrogen peroxide
- □ Bandage scissors
- □ Instant cold packs/hot packs
- □ Exam gloves
- □ Barrier device for CPR
- □ Blanket/towel (to help treat hypothermia)

Field Gear (for Scout Stations and Ranger Posts)

- □ Binoculars
- □ PPE Kit (see above)
- □ First Aid kit (see above)
- □ Flashlight
- □ GPS device (if available)
- □ Cell phone
- □ Disease event reporting form (see Section 3)
- □ Clipboard
- □ Carry cooler with ice packs (for samples if conducting necropsy)
- □ Necropsy kit (see below)
- □ HALI Scout Handbook
- □ Sampling/Necropsy Equipment (to be used under direction of a veterinarian or qualified animal health technician)

Documentation:

- □ Camera (digital if available)
- □ Field notebook or reporting form

Necropsy kit (to be stored at veterinary clinic or park headquarters):

- □ Sharp knife (including sharpening stone or steel)
- □ Scissors (small and large)

- □ Forceps
- □ String
- □ Axe or hatchet
- □ Hack saw or bone saw
- □ Small and large shears
- □ Chisel and mallet
- □ Scalpels and razor blades
- □ Alcohol lamp or gas burner for sterilizing instruments
- □ Plastic ruler or measuring tape
- □ Specimen containers and sampling equipment
- □ Rigid plastic containers with tight fitting lids (1L)
- □ Small vials, tissue cassettes, or tags to identify samples
- □ Sterile vials/blood tubes
- □ Plastic bags with closure tops (zip lock or whirl pack)
- □ Parafilm or sealing tape
- □ Aluminum foil
- □ Sterile syringes and needles (20g)
- □ Sterile swabs in transport tubes
- □ Labeling tape or tags
- □ Waterproof pens and pencil
- □ Microscope slides and slide boxes for transport
- □ WHO rabies kit (or drinking straw in small jar of glycerin)

Transport materials:

- □ Ice cooler
- □ Leak-proof/break-proof container
- □ Absorptive packing materials
- □ Sealing tape
- □ Sterile buffered glycerin (50%)

Fixatives:

- □ 10% buffered formalin
- □ 100% acetone for slides
- □ 70% ethyl alcohol for parasites

Disinfecting materials

- □ Bucket and brush
- □ Disinfectant (bleach)
- □ Borax
- □ 70% ethyl alcohol (for disinfecting instruments)
- □ Shovel

Equipment (to be stored at park headquarters or veterinary clinic)

- □ Microscope
- □ Centrifuge

Are there any other supplies or resources that are important for scouts and rangers working in your area?

_____

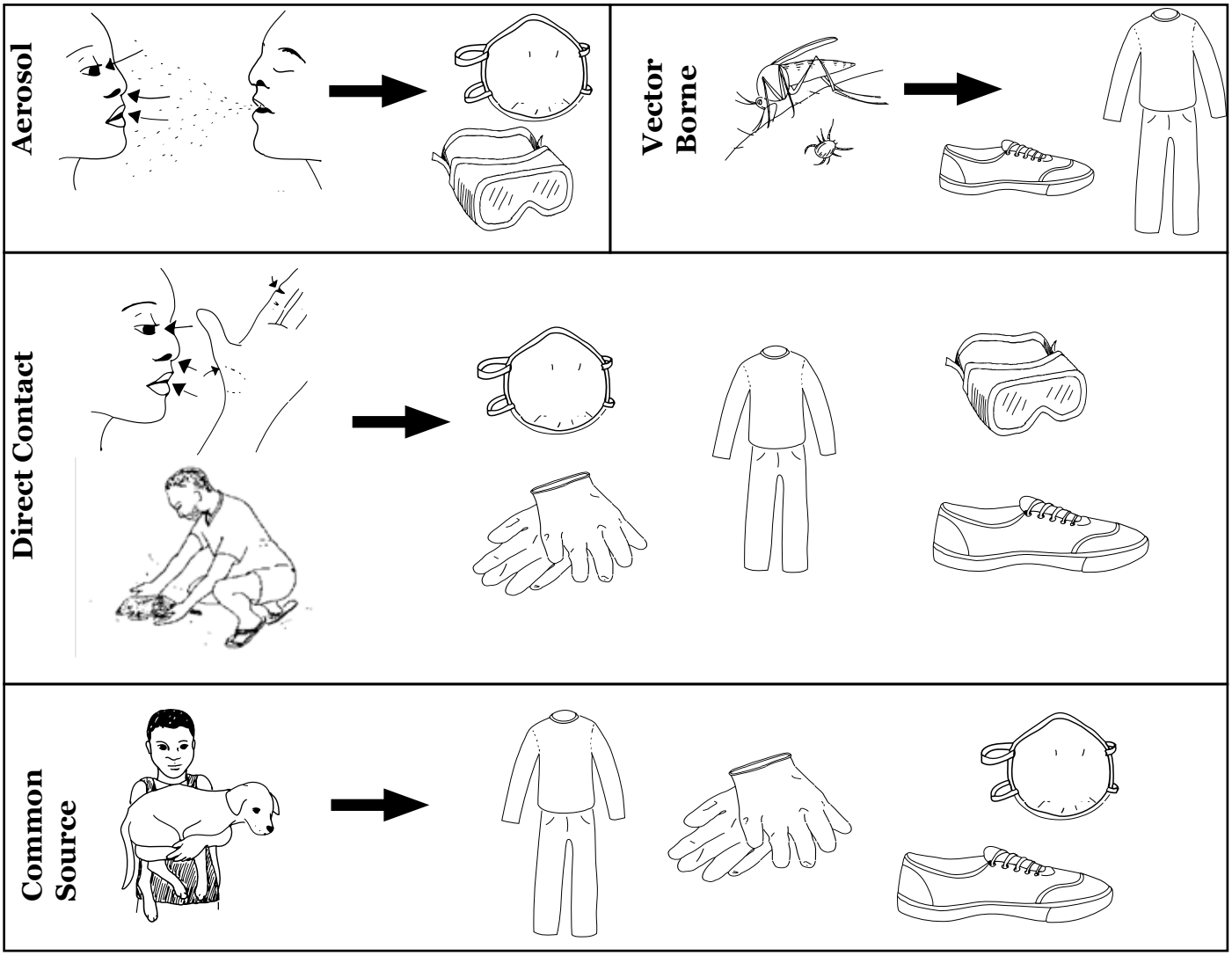
_____

_____

Appendix E

Wildlife Health Quick Reference Guide

How to protect yourself from disease transmission



How to prevent infection?

Sample Disease Event Report Form

Date:	Time:
Scout name (individual identifying the event):	
Scout organization (or affiliation of individual identifying the event):	
Scout contact information: Cell phone: Address:	
Location (name or identifying features): Latitude (if known): Longitude (If known):	
Species affected:	
Number of animals affected:	
Signs of disease:	
Samples collected:	Yes No
Types of samples collected:	
Other observations:	

Who do you report to in your area?

Local veterinarian (District/Park Veterinarians)
Name(s): _____
Tel(s): _____

Park authorities (Park ecologist/warden)
Name(s): _____
Tel(s): _____

Local wildlife authority (Game officers)
Name(s): _____
Tel(s): _____

Head Scout(s) or Ranger(s)
Name(s): _____
Tel(s) : _____

Other important people to inform?
Name(s): _____
Tel(s): _____