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Investigating Sudden Death in Beef Cattle Herds on Range or Pasture

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Introduction

Few events are more alarming in cattle ranching than finding more than one dead animal on pasture where the cause of death is not immediately apparent. In the United States in 2017, 45.3 percent of cow-calf operations reported the death of one or more beef breeding cattle (USDA 2020). Between the years 2000 and 2011, almost 500 cases of suspected poisonings in beef cattle were submitted to the California Animal Health and Food Safety laboratory system (CAHFS) (Varga and Puschner 2012). There are a limited number of possible causes of sudden death in a group of cattle that seemed healthy prior to their demise. A systematic approach in ruling out likely causes will help determine the problem. First and foremost, it is always advisable to involve a veterinarian as soon as possible in the investigation. If a toxin or nutritional problem is high on the list of suspicions, removing the remaining cattle from the pasture or switching feed may avoid further losses and should be done immediately.

Although pasture or feed removal may limit losses, finding the cause of sudden death is important so that precautions can be taken to prevent the situations that have led to the deaths—or protective measures can be implemented for the rest of the herd. Once the cause has been determined, records should be kept of what happened, what was done to determine the outcome, and what the outcome was, so this information can be referred to in the future.

Finding the cause includes gathering data, interviewing witnesses, and evaluating evidence. The following information begins with a comprehensive description of the steps involved in the investigation and why they are important. Then we present a more thorough description of the most common causes of sudden death in groups of beef cattle in California. Finally, we offer a few examples of how this information can help identify possible causes of death. This publication guides users on how to use the provided data collection form in an investigation of sudden death for beef cattle herds (appendix A). The completed form can be shared with a veterinarian, livestock advisor, or diagnostic lab to ensure they have all the information necessary to assist in determining the cause of death. For more information, please refer to UC Agriculture and Natural Resources publication, "How do I submit tissue samples for necropsy testing at CAHFS diagnostic lab?" as well as two videos on how to conduct field necropsies in a calf and a cow (Woodmansee 2022; UC ANR 2023a, 2023b).

Steps in investigating sudden death in beef cattle

Data gathering, interviewing witnesses, and evaluating evidence are part of the investigative process.

Data gathering

Data gathering should start with the "Five *W's* and How" (who, what, where, when, why, and how to answer these questions).

Who, as in "Who died?"

The following is a list of demographic information and history about the dead cattle that may be useful for determining a cause of death:

- The death of a single animal may be an isolated event due to a subclinical condition that was not readily apparent until the

animal succumbed to the disease. The term *sudden death* becomes relative, depending on how often cattle are observed. However, multiple animals dying at the same time or in short succession points toward a herd health problem, which is the focus of this publication.

- Young or suckling calves are susceptible to different diseases than weaned calves, and adult animals have their own set of diseases they are more likely to be affected by. If they are female, what reproductive stage are they in? If they are pregnant, what stage of pregnancy are they in? Stage of pregnancy or lactation alters nutrient requirements and the immune status of cows and heifers. Late pregnancy and early lactation increase calcium and magnesium demands. Cases of milk fever, also known as *hypocalcemia*, can occur in fresh beef cows even though this problem is typically associated with dairy cows.
- The sex of the cattle is also important. If only male calves are dying, for example, recent castration could be the source of the problem. Castration bands can predispose calves to tetanus infection and surgical castration can result in fatal hemorrhage.
- Even though genetic disorders are rare, if all affected animals are of one breed and there are multiple breeds in the herd, genetic disorder becomes a significantly more likely cause of death. Some breeds are more susceptible to certain diseases than others or are known for potentially carrying lethal genes (Manteca et al. 2001; Watanabe et al. 1979).
- Several issues in the history of affected animals can merit a closer look:
  - **Health:** Has there been a recent health problem, such as respiratory disease, diarrhea, lameness, or abortions, in the herd or in the dead animals? Sometimes, clinical disease, with obviously sick animals, is only the tip of the iceberg. Many others in the herd could be subclinically affected. Individual cattle could become overwhelmed by an ongoing underlying problem that results in multiple deaths. Another component of health history requires a closer look at any drugs the affected animals were treated with in the days prior to death. Although rare, drugs given to cattle may have been tainted or rendered unsuitable for use either at the manufacturer or through contamination or mishandling at the ranch. Drugs used inappropriately, such as dexamethasone given to an immune-compromised animal, or a drug overdose, may be the reason for death. Also, if there was a cluster of deaths in the herd in the past, what were the similarities and differences? Chances are that a problem that occurred in the past returns if the underlying cause is no longer being addressed, such as a lapse in vaccination or biosecurity.
  - **Vaccination:** What have members of the herd, particularly those that died, been vaccinated for, when were they vaccinated, and how many times? Was there a change in the type or manufacturer of the vaccine in the months prior to this event? Good record keeping is important, and this is a situation where it becomes especially critical to be able to go back and verify exactly which vaccines the herd received. Vaccines come in different forms, such as modified live or killed. Modified live vaccines are more sensitive to mishandling and the investigation could eventually uncover a vaccination breach, such as a refrigerator where vaccines were stored at improper terperatures. All letters on a vaccine bottle have an important meaning. "FP," for example, stands for fetal protection, and "TS" means temperature sensitive.
  - **Travel:** Have affected cattle or other cattle in the herd recently traveled to a different part of the state or been shown at a fair? Some diseases, such as anaplasmosis, are only present in certain areas. A recent travel history, within the last month or two, could provide relevant information that may lead to a possible cause.
  - **Nutrition:** Feed can be a problem because of acute or chronic toxicities caused by feedstuffs. Acute toxicities are due to recent exposure to a potent toxin. Examples include oleander (Galey et al. 1996) (fig. 1) or water hemlock exposure, ionophore overdose, or nitrate toxicity. Chronic toxicities cause death by long exposure to small amounts of toxins that accumulate in the body and eventually kill the animal, including *Pyrrolizidine alkaloids* in plants such as fiddleneck or groundsel (Shimshoni et al. 2015). There are a lot of toxic plants that can cause death, and it is

Figure 1. Brush piles (A) may be the source of inadvertent poisonous plant exposure with the most common being oleander leaves. Fresh oleander leaves (B). *Photos*: A: J. J. Gouin/Shutterstock.com. B: T. Becchetti.

beyond the scope of this article to describe all of them. A good reference is UC Agriculture and Natural Resources publication 8398 "Livestock Poisoning Plants of California" (Forero 2011). Other information on nutrition that should be evaluated includes whether there were any recent changes in nutrition, such as a new pasture that had not been grazed before (BVA 2014), or a new batch of hay, mineral, or other supplement. One of the classic ways cattle get plant poisoning is from yard clippings that are offered to them (Suter 2002). It is also possible there were changes in the composition of feedstuffs offered, for example introduction of cull vegetables, distiller's grains, Monensin (Gabor and Downing 2003), and so on.

- **Herd additions:** Whether the affected animals are new additions to the herd or whether other animals that are currently healthy have recently been added to the herd may provide useful information for the cause of death investigation. If the dead animals are new additions, they could have succumbed to a stress-related disease, such as respiratory disease, that can be precipitated by a long haul, a new climate, or the stress of weaning. Herd additions may not be immune to or vaccinated for a disease or diseases that are endemic in the herd, such as anaplasmosis or anthrax. On the other hand, new additions could also be the source of disease introduction to a susceptible herd. Problems related to herd additions can be prevented by implementing a minimum quarantine period of 30 days for new stock, in combination with diagnostic testing and administration of appropriate vaccinations and good nutrition.
- **Management procedures:** Did affected animals undergo any procedures, such as castration, vaccination, dehorning, deworming, or application of other parasiticides? Castration and dehorning can make the animal susceptible to infections like tetanus or cause excessive blood loss that results in shock. Although rare, vaccinations act as allergens that trigger an immune response and can lead to anaphylactic shock, a severe, life-threatening allergic reaction. Chemicals such as dewormers or other parasiticides often have large margins of safety, but overdose may lead to death.
- **Environment:** Identifying any recent changes in the environment is tricky because of the wide range of possibilities. Some questions to ask when thinking about environmental factors that could have led to cattle death include: Have there been any fertilizer applications to pastures or could there be any toxins in the environment that cattle have access to, such as heavy metals in car batteries or old paint? What was the weather like in the days leading up to the deaths? Has a weather event like snow limited access to usual feedstuffs and forced livestock to consume alternative, potentially toxic plants? And is there free access to a quality water source and has it changed recently? Situations that should raise suspicion for environmental causes of death include abrupt changes or prolonged harsh conditions. Hot weather can

lead to blue-green algae blooms in ponds. A windy day can push the algae to one side of the pond where they concentrate. If cattle have access to part of the pond where algae accumulate, exposure can be fatal. Weather patterns that increase the spring grass growth rate can lead to hypomagnesemia, otherwise known as grass tetany (Smith and Edwards 1988). Thunderstorms are rare in California, but a recent thunderstorm with dead cattle found close to a tree might point to a lightning strike as the cause of death (Vanneste et al. 2015).

What was observed in the animals that died?

A lot of information can be gleaned from inspecting a carcass, even if it is only on the outside. Pictures can be a valuable form of documentation that may prove useful in documenting the scene, carcass condition, and the affected animals' identification. When possible, include ear tags in the pictures. However, carcasses become compromised quickly, especially in hot weather. Some of the suspicious information that can be observed is an artifact of the process of decomposition and has nothing to do with the actual cause of death of the animal. The bacteria in the rumen of dead animals will continue to produce gas so dead cattle often look bloated quickly. Scavengers might also be quick to feast on the remains, which can lead one to believe that trauma was involved in the death of the animal. The following are items that should be considered when inspecting a carcass:

- **Signs of trauma:** Are there any signs of trauma, such as broken skin, puncture wounds, or bite wounds? The tell-tale sign for distinguishing between predation and scavenging or carrion feeding is the presence of blood either at the point(s) of attack on the carcass or around the kill site. The body may also be stretched out in an unnatural position if the animal was killed by a predator. If the animal died from natural causes, the body is more likely to be curled up with the legs tucked under the body. If the body has been scavenged, there will be lacerations or puncture wounds but no signs of bleeding on the inside of the hide when the carcass is opened. If an attack is suspected, the type and location of the wounds can offer an idea of what predator species was involved. Wolves will mostly attack from behind, while cougars will target the skull or throat area. Coyotes and domestic dogs may attack at either end, but coyotes tend to hunt small animals and leave small punctures and lacerations due to their small body size.
- **Presence of fluid:** Blood-tinged fluid (purge) from decomposition may be present regardless of the cause of death (Alberta Government 2018). It is important to distinguish between decomposition fluid and frank blood to determine whether trauma was a potential cause of death.
- **Bloat and saliva around the mouth:** As mentioned before, dead ruminants will bloat because of the continued function of rumen bacteria after the animal's death without eructation of the gas. If the cattle died from bloat, the rear abdomen will be edematous (swollen), and pushing a finger on the area will leave a pitting mark. If the animals died from choke—a foreign object that blocked the entrance to the rumen—there will be a lot of saliva around the mouth (Smith 2008).
- **Signs of convulsions or a struggle:** Is the ground around the animals disturbed? Some metabolic conditions, such as grass tetany or low blood calcium, as well as some neurologic conditions, such as lead toxicity, polioencephalomalacia, or bacterial meningoencephalitis, can cause seizures and death (D'Angelo et al. 2015).
- **Signs of anthrax:** Dark nonclotted blood exuding from the nose or anus, or an absence of rigor mortis, are indicators of anthrax. It is very important not to open any carcasses if anthrax is suspected. Contrary to common belief, an ear is not the best sample to take to diagnose anthrax. Instead, have a veterinarian collect ocular fluid. Ocular fluid can be collected without contaminating the environment, while tissue samples such as an ear may contain normal bacterial flora that can mask the presence of the bacteria that cause anthrax (Bengis and Frean 2014; Brawand et al. 2019).
- **Gas trapped under the skin:** Cattle that die from pneumonia can, due to increased breathing effort, have air trapped under the skin high up on the chest where the ribs meet the spine. This air creates a bubble-wrap feel. Cattle that die from blackleg may have a buildup of gas in their thigh muscles produced by the bacteria that caused the disease. The gas buildup can result in crackling sounds when pressing on the legs.
- **Signs of diarrhea:** Is the rear end soiled with feces, especially in calves, where diarrhea can often be fatal? Is the diarrhea bloody? Bloody diarrhea and

the calf's age can be a clue as to the causative agent. Typically, if the calf is 3-weeks to 6-months-old, the bloody diarrhea could indicate Coccidia species. If they are 7- to 10-days-old, it could indicate Coronavirus. If they are 2-weeks to 2-months-old, it could indicate Salmonella.

- **Discolored mucus membranes:** Are there any discolorations on the inside of the mouth, vulva, or anus? Are those mucous membranes yellow, which can be sign of liver disease or anaplasmosis? Are there little red dots (petechia), which can be an indication of sepsis?

Where did they die within the ranch and within the ecosystem/environment?

The location of where dead cattle are found can also be helpful in determining the cause of death. Some toxins can kill animals very quickly, so the location where the animals are found may give an idea about the cause of death. Potential location-specific toxins include:

- If dead animals are found in close proximity to a pond during warm weather, blue-green algae are a possible as a cause of death.
- Cattle dying from botulism due to a contaminated food source will be close to a food trough.
- If the dead cattle were housed in barns, one should consider exposure to toxic gases (carbon monoxide, hydrogen sulfide, nitrogen dioxide), especially if ventilation is poor or there is exposure to any chemicals, such as pesticides, stored in the structure (Bertin et al. 2013). If dead cattle are found in a barn, it is important to immediately ventilate the area so that people are not exposed to the same toxins.
- Copper is used as a fungicide and algicide in orchards or irrigation canals. Grazing in former orchards or irrigating with water treated with copper-containing chemicals can lead to acute or chronic copper toxicity. Fertilizer application can lead to nitrate toxicity. Old car batteries can be a source of lead poisoning (fig. 2) if cattle are licking them (Logner et al. 1984). High salinity or nitrates in water sources can cause toxicity and death. Broken water sources can cause water deprivation and subsequent salt toxicity, killing cattle (Osweiler et al. 1995).

When is the timing of the deaths relevant to other events?

Certain times of the year pose high-risk levels for certain diseases—such as in the spring, when the grass is lush and can cause fog fever or grass tetany, or after a drought-ending rain or when plants are immature, when nitrate toxicity can be a concern (BVA 2014; Strickland et al. 2017). Environmental history is especially relevant when considering the timing of the deaths. See the previous section regarding environmental history to learn more.

Figure 2. Car batteries or old paint containing lead left in fields, barns, or sheds where cattle have access can result in toxic lead exposure. *Photo*: J. Davy.

Why did they die?

Any additional information on the suspected cause of death can be helpful. For example, knowing if there have been similar cases in the past on the same ranch or at a neighbor's ranch could help narrow down potential causes by comparing similar conditions. It is important, however, to keep an open mind and not jump to conclusions about a possible cause. In particular, if foul play is suspected, evidence should be weighed very carefully before pursuing this line of thought further. In general, the most likely and common causes should be ruled out first before pursuing any rare or exotic causes.

Interviewing witnesses

Witnesses in this context are any individuals who are responsible for the care of the animals in any capacity. Witnesses could also include suppliers of products, such as feed, supplements, vaccine companies, or sales representatives who have not been in direct contact with the animals but who are responsible for the quality of products given to the animals. Saving samples of products or feedstuffs that have recently been given or introduced to the herd—as well as writing down information about commercial products, such as their batch numbers, or taking pictures of the packaging—can be helpful later in the investigation. Contacting the manufacturer of any products

that are suspected to have caused harm to cattle may be useful in alerting them to a potential problem and preventing further deaths. If evidence can be presented that indeed the product was at fault, such as a mixing error at a feed mill leading to poisoning, the manufacturer may be willing to enter into negotiations for compensation. Unfortunately, situations in which large monetary compensations for production losses are sought can lead to long legal battles.

Evaluating evidence

Evidence could be in the form of samples collected from the animals (blood, tissues, urine, feces), photographs taken of the animals, samples of feed or vegetation with obvious signs of grazing (particularly samples of unknown broadleaf plants), or supplements and injectables that the animals received. Whether you submit samples to the CAHFS lab, your veterinarian, or another diagnostic lab, follow the steps outlined in the UC Agriculture and Natural Resources fact sheet "How do I submit tissue samples for necropsy testing at CAHFS diagnostic lab?" (Woodmansee 2022).

- **Step 1:** Take pictures of the carcasses and their surroundings:
  - potential poisonous plants
  - suspicious water sources
  - the carcass as a whole
  - close-ups of anything unusual about the carcass, such as wounds, discolorations, or bodily fluids
- **Step 2:** Call the CAHFS lab to discuss your case before sampling to make sure you are collecting the right type of samples in the correct containers.
- **Step 3:** Gather and prepare your sampling equipment and review your sampling strategy for animal tissues and other samples, such as feed. Sampling equipment as seen in figure 3 includes:
  - disposable gloves
  - dedicated necropsy knife, sharp and clean
  - garden shears/loppers
  - Ziploc bags in several sizes (sandwich to gallon size)
  - tweezers
  - scissors
  - leakproof disposable sampling cups, such as urine cups or fecal cups
  - clean syringes and needles

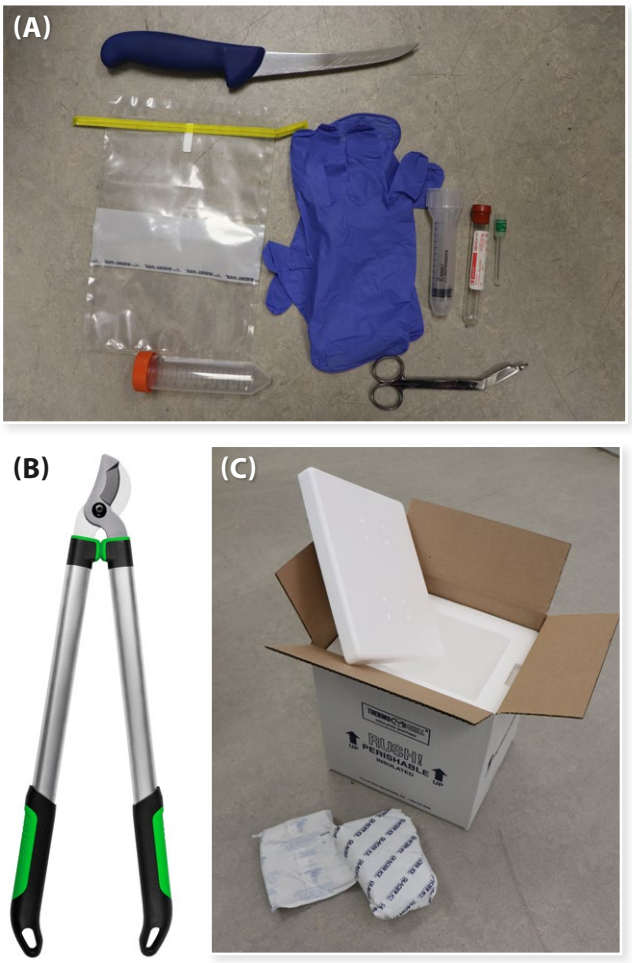

Figure 3. Sampling equipment to have on hand while conducting a field necropsy: sharp dedicated knife, scissors, gloves, sampling containers, blood tubes, syringes, needles (A); garden shears (B); Styrofoam shipper and ice packs (C). *Photos*: A: CAHFS lab. B: Mirage_studio/Shutterstock.com. C: G. Maier.

  - blood tubes (red top, purple top, green top)
  - disposable ice packs stored in a freezer that are ready for shipping when necessary
  - Styrofoam containers in a cardboard outer box for sample shipping
- **Step 4:** Collect samples.
  - The best chance of finding the cause of death if you experience any losses in your herd is by submitting a fresh carcass to a diagnostic lab in combination with a thorough medical and environmental history and a consultation with your veterinarian. If this is not possible, you may be able to collect and store feed and carcass samples to be sent to a laboratory. Getting veterinary advice prior to collecting samples is highly recommended. In addition,

taking pictures of the dead animal as well as the environment—while focusing on any of the signs discussed previously—may become important.

- If you have never performed a field necropsy, it is best to have your veterinarian show you how to do it before you attempt it yourself. The authors have created two YouTube videos demonstrating how to perform field necropsies in a calf and a cow (UC ANR 2023a, 2023b), respectively. The videos can also guide you through the process. You should always wear gloves when performing a necropsy and wash your clothes afterwards to protect you and your family from any pathogens that may be present in the animal. Avoid performing a necropsy if you suspect anthrax—that is, when you see blood from the anus, the mouth, or the vulva and there is no rigor mortis. Keep in mind that a carcass of an animal that has died more than 24 hours ago will likely not yield any useful information because the tissues will have already started to degrade.
- Perishables, such as feed samples, can be stored in a freezer, unlike animal tissues, which will become compromised if frozen. The type and quality of the sample collection and storage can impact whether the diagnostic lab will be able to find an answer. For example, the best sample to take to detect hypomagnesemia is not a blood sample but a sample of vitreous humor from the eyeball. Be sure to be thorough and accurate in your sample collection according to the suspected cause of death. All samples should be double bagged in case there is leakage. Ship them on ice with plenty of padding material unless you are told otherwise.

Common causes of multiple deaths in beef cattle herds

The following list of nutritional/toxic, infectious, and traumatic causes of death serves as a reference guide to diagnosis, sample collection, and immediate action.

Nutritional/toxins

- Grass tetany
  - **Risk factors:** lush green pasture, heavily fertilized pasture, cows in peak lactation
  - **Signs:** sudden death, signs of pedaling (signs of limb flailing while the animal is on its side), excitability, muscle twitching, stiff gait
  - **Diagnostic samples:** whole eyeball or vitreous humor in a red-top tube, shipped on ice to the diagnostic lab
  - **Immediate action:** move herd to a different pasture or provide alternative feed source (good quality hay or sileage, Epsom salts in water to provide magnesium)
- Nitrate toxicity
  - **Risk factors for feed:** excessive nitrogen fertilizer, cloudy weather, frost during plant growth, drought, nitrate accumulators (Sorghum-Sudangrass)
  - **Risk factors for water:** manure or fertilizer runoff into stock water, heavy rain or wet years
  - **Signs:** depression, staggering, blue-grey mucous membranes, chocolate-colored blood (rare)
  - **Diagnostic samples:** feed, water
  - **Immediate action:** provide alternative feed source, discard or dilute hay
- Most common toxic plants: oleander, gossypol, Japanese yew (Sula 2013), poison hemlock, fiddleneck or groundsel containing *Pyrrolizidine alkaloids* in the hay
  - **Risk factors:** feeding yard clippings, overgrazed and weed-infested pasture
  - **Signs:** can vary depending on the toxin; only a few leaves of oleander (see fig. 1) are enough to kill a cow
  - **Diagnostic samples:** feed source, rumen contents
  - **Immediate action:** remove suspected feed source or fence off and provide an alternative feed source
- Blue-green algae
  - **Risk factors:** warm weather, stagnant water, nitrogen or phosphorus fertilizer runoff, manure-contaminated water ponds
  - **Signs:** sudden death, bloody diarrhea, weakness, confusion

  - **Diagnostic samples:** water, shipped on ice to the diagnostic lab
  - **Immediate action:** prohibit access to pond and provide an alternative water source
- White muscle disease in calves (selenium/vitamin E deficiency)
  - **Risk factors:** selenium-deficient soil, lack of vitamin E in feed at the end of a dry season
  - **Signs:** sudden death, stiff gait, or labored breathing in calves
  - **Diagnostic samples:** whole blood in a purple-top tube containing ethylenediaminetetraacetic acid (EDTA)
  - **Immediate action:** selenium injections for all calves
- Lead toxicity
  - **Risk factors:** exposure through paint or car batteries (see fig. 2)
  - **Signs:** confusion, blindness, abnormal behavior, excitability, convulsions
  - **Diagnostic samples:** brain or whole head
  - **Immediate action:** remove lead source
- Rumen impactions
  - **Risk factors:** exposure to trash (plastic bags, bailing twine), almond hull feeding, access to acorns with little other feed
  - **Signs:** depression, decreased appetite, distended abdomen, reduced manure production
  - **Diagnostic samples:** perform a necropsy
  - **Immediate action:** clean up the pasture, offer alternative feed sources

Infectious

- Anaplasmosis
  - **Risk factors:** naïve animals over 2 years of age, introduction of naïve animals to endemic area, introduction of infected animal to naïve herd, needles, taggers, and other tools used on multiple animals with mixed infection status
  - **Signs:** depression, labored breathing, aggression, pale mucous membranes
  - **Diagnostic samples:** serum, whole blood
  - **Immediate action:** treat the sick, vaccinate the naïve (a killed vaccine requires two doses, 3 to 4 weeks apart), but most importantly, consult a veterinarian for more accurate action points and a long-term plan
- Anthrax
  - **Risk factors:** endemic area, soil disturbance, break in vaccine coverage
  - **Signs:** sudden death, nonclotting blood from orifices (nose, mouth, anus), high fever, difficulty breathing
  - **Diagnostic samples:** it is recommended to have a veterinarian take the sample; do not open the carcass
  - **Immediate action:** call the animal health branch in your district as well as a veterinarian, *check with local authorities*, deep burial or burning of dead cattle

Anthrax

Anthrax is a notifiable disease.

- Clostridial diseases: blackleg (*Clostridium chauvoei*), redwater (*Clostridium hemolyticum*), tetanus (*Clostridium tetani*)
  - **Risk factors:** most are ubiquitous in soil; skin wounds, castration sites, or the umbilicus offer entry sites for bacteria; liver flukes, common in pastures with vernal pools (fig. 4), are a risk factor for redwater
  - **Signs:** blackleg: sudden death, tremors, unsteady gait, fever, lameness, depression; redwater: port wine-colored urine (rare), jaundice (fig. 5); tetanus: protruding third eyelid, stiffness, tremors, lockjaw, easily startled
  - **Diagnostic samples:** blackleg: skin and muscle; redwater: liver; tetanus: diagnosis usually made based on clinical signs, no good laboratory tests are available
  - **Immediate action**: investigate a possible vaccination breach, revaccinate survivors
- Enterotoxemia (overeating disease)
  - **Risk factors:** neonates, well-fed, rapidly growing animals
  - **Signs:** yellow/brownish or bloody diarrhea, convulsions, trembling
  - **Diagnostic samples**: intestine

Figure 4. Snails, the intermediate host for liver fluke larvae, may live in vernal pools on pasture. Liver flukes can predispose herds to redwater disease caused by *Clostridium hemolyticum*. *Photo*: T. Becchetti.

Figure 5. Jaundiced or icteric mucous membranes in cattle can be a sign of liver disease, such as liver toxins or leptospirosis. They can also be a sign of red blood cell destruction, such as that caused by anaplasmosis. *Photo*: Nadee photography 2019/Shutterstock.com.

  - **Immediate action:** reduce grain in feed, investigate a possible vaccination breach
- Bovine Respiratory Disease (BRD) from Bovine Respiratory Syncytial Virus (BRSV), Pasteurella/Mannheimia
  - **Risk factors:** transport, weaning, any stressful situations, smoke/dust
  - **Signs:** coughing, nasal discharge, abnormal breathing, depression, no interest in feed, fever
  - **Diagnostic samples:** lung
  - **Immediate action:** consider metaphylaxis in consultation with a veterinarian, or treat cattle showing signs with antibiotics

Trauma

- Predation: coyotes, mountain lions, wolves, domestic dogs
  - **Risk factors:** newborns and young stock are most susceptible
  - **Signs:** blood on the carcasses and the surroundings, obvious bite marks, body stretched out in an unnatural position
  - **Diagnostic samples:** photos, carcasses
  - **Immediate action:** report the incident to the Wildlife Incident Reporting System (California Department of Fish and Wildlife 2025), inform neighbors, increase deterrents or remove cattle

Real-life examples of sudden death scenarios in beef cattle

From grass clippings to old cans of paint, the following examples demonstrate how simple oversights can have dire consequences.

Deadly grass clippings

Six cows on dry range were found dead near each other in late summer. All of the herd's vaccinations were up to date, calves had already been weaned and shipped, and the cows were bred. No obvious cause of death was apparent. In interviewing witnesses, it was discovered that a gardener at a neighboring house finished mowing the green yard and felt bad for the cows on dry, dead annual grasses. He dumped the clippings in the pasture assuming he was doing something nice for the cows. Oleander bushes grew around the house and some of the leaves that had

fallen from the bushes were picked up by the mower, mixing in with the grass clippings. Enough of the oleander leaves were present in the clippings to kill six of the cows in the herd. The diagnosis was made after samples of the clippings were sent to a diagnostic lab, which confirmed the presence of oleander leaves and therefore oleander toxicity as the cause of death.

Vaccination breach

Three bred springer heifers grazing annual rangelands among a small herd of beef cows in spring died over the course of a few weeks. The owner believed the herd's vaccinations were up to date. There was an adjacent vineyard that had recently been sprayed with a chemical. During a site visit by Cooperative Extension personnel, grazing sites were found to have small amounts of the cardiotoxic showy milkweed (*Asclepias speciosa*). Although milkweed toxicosis was considered, it was determined that the plant wasn't present in sufficient quantity to result in any deaths. There were also vernal pools that were starting to dry (see fig. 4). During necropsy, the cause of death was determined to be redwater. After further inquiry of the owner, it was found that improper handling of the vaccine led to inadequate protection from *Clostridium hemolyticum*. The history of flukicide application to these cattle was unknown, but lack of treatment for liver flukes may have contributed to the situation as well.

Licking lead

After several days of being absent, a cattle producer found calves stumbling and disoriented, as well as some dead calves. Feed and water were available, and vaccinations were up to date. One live calf was brought to the UC Davis Veterinary Medical Teaching Hospital and a dead calf was brought to the CAHFS diagnostic lab. Because of the neurologic presentation in the live calf, carcass samples were tested and found positive for lead. The source of the lead was determined to be old paint that was stored in a shed just off the pasture that calves had gained access to when they broke through a fence.

Ryegrass staggers

Six Angus cows died after developing neurologic signs 1 to 2 hours after being fed a new bale of hay. No toxic weeds were observed by the toxicologist in the submitted feed sample. Multiple lines of inquiry were investigated. Neither nitrates, oleander, or *Microcystins* were detected in the hay samples. However, lolitrem neurotoxins found in endophyte-infected perennial ryegrass were detected in the hay. Lolitrems, primarily lolitrem B, are the causative agent of ryegrass staggers in livestock, which caused the demise of the cows.

Copper toxicosis

A previously healthy cow was found dead. A murky water source and cocklebur growing in the pasture raised suspicions for either blue-green algae or cocklebur toxicosis. The submitted rumen contents did not contain *Microcystins* (the hepatotoxic blue-green algal toxins) or *Carboxyatractyloside* (the toxin in *Xanthium strumarium*, or cocklebur). The major necropsy finding was diffuse liver congestion and necrosis. The liver also had a high concentration of copper, which accumulates in the liver during overexposure. Once a certain toxic threshold (>250 ppm) is reached, copper may be released from the liver into the bloodstream. Copper is a strong oxidizing agent and may lead to an acute hemolytic crisis (massive destruction of red blood cells) with hepatic necrosis, icterus (see fig. 5), hemoglobinuria, and hemoglobinemia. In cases of suspected overexposure to copper, it is prudent to also evaluate kidney copper concentration.

Locoweed and Anaplasma

An Angus cow was submitted for necropsy following the death of six herd mates (five of middle age, one yearling) that lost coordination and eventually collapsed. The animals grazed on a dry grass pasture and were supplemented with grassy alfalfa every 4 days. The water source was a natural spring. Locoweed and wild fig trees were present on the pasture. Icterus/jaundice (yellow mucus membranes) were observed. During necropsy, a low red blood cell count, as well as ingestion of Locoweed, was found. Neurologic signs in this case were associated with the ingestion of Locoweed containing swainsonine, which inhibits normal cell metabolism. The icterus was associated with an Anaplasma infection. Severe anemia caused by Anaplasma can also present with incoordination from low levels of oxygen.

Conclusion

Collecting data and samples, writing up a comprehensive history, and working with a veterinarian or a diagnostic laboratory will increase the chances of determining the cause of death of beef cattle and allow for appropriate corrective action.

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