Master of Public Health

Integrative Learning Experience Report

COMMUNICATING ABOUT ZOONOTIC PARASITES IN PURSUIT OF PUBLIC HEALTH: TRANSMISSION AND PREVENTION AT THE HUMAN-WILDLIFE INTERFACE

by

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Summary

North America is home to a multitude of zoonotic parasites and their wildlife hosts. The evolving human-wildlife interface presents many opportunities for zoonotic spillover, especially through wildlife-centric activities such as hunting, trapping, research, or conservation. This Applied Practice Experience (APE) seeks to characterize the risk posed by zoonotic parasites in wildlife, identify species of concern, recognize points of zoonotic transmission, and formulate preventive strategies. This information is organized and condensed into two products: an evidence-based, best-practice manual covering select zoonotic endoparasites in North American wildlife, and a commentary article discussing the key points regarding zoonotic parasitic transmission and prevention. Both products are tailored to a largely non-academic audience, implementing multimodal communication strategies to translate key concepts from scientific literature to accessible materials while preserving scientific integrity. This portfolio required a multidisciplinary approach inclusive of the public health, veterinary, and wildlife fields and emphasizes the importance of systems thinking when addressing the complexities of zoonotic disease transmission.

Subject Keywords: Zoonotic Parasitology; Emerging Infectious Disease (EID); Human-Wildlife Interface; One Health

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Chapter 1 – Introduction to Zoonotic Endoparasites in Wildlife

General Ecology of Endoparasites in North American Wildlife

North America is home to a wide array of wildlife species and their parasitic counterparts. Over the last several centuries, humans and wildlife have struggled to find a balance; as human populations increase and urbanization creeps over the landscape, the human-wildlife interface is constantly evolving. Local wildlife species have adapted their lifestyles around bustling cities, livestock operations, and vast lengths of farmland, increasing the level of indirect contact experienced by both people and wildlife. While most Americans no longer rely on wild game for subsistence, hunting, studying, or rescuing wildlife remains a significant way of life for many people. These interactions create avenues for zoonotic disease transmission, sometimes resulting in severe, chronic, or even fatal human disease.

Zoonotic Parasites as Neglected Infectious Diseases

Parasites, harbored within a large percentage of North American wildlife, represent an important category of wildlife zoonoses. Parasites, by definition, require a host to survive, and are nearly ubiquitous in wildlife populations (Jenkins et al., 2015). Wildlife are reservoirs of disease—it is estimated that 75% of emerging infectious diseases (EID) worldwide are zoonotic in origin (Mackenstedt, Jenkins, and Romig, 2015) and 60% of human pathogens initially originated from domestic or wild animals (Deiana, et al., 2024). Parasitic pathogens comprise a smaller portion of EIDs compared to viral and bacterial pathogens, but they pose a serious threat to human health and infection may result in lifelong or even fatal consequences.

Despite the potential for severe human disease, there remains a deficit of information regarding parasitic infections in North America. In response, the Centers for Disease Control and Prevention created a list of neglected parasitic infections (NPIs) in the United States, as defined by the following key characteristics:

1) The surprisingly large number of persons infected or at risk, especially those living in poverty
2) The potential for underreporting and missed diagnoses, largely because of a lack of clinician awareness and poor availability of optimal diagnostic tests
3) The dearth of interventions that can prevent or cure illness

This list includes three zoonotic parasitic diseases that may be contracted from wildlife: toxocariasis, cysticercosis (indirectly), and toxoplasmosis (Parise, Hotez, & Slutzker, 2014).

Evaluating the true prevalence of zoonotic parasitic diseases in people and their potential for severe disease is difficult. Surveillance of human parasitism largely relies on serological data, which identifies exposure rather than active infection. Furthermore, individuals who have been exposed to parasites and were initially asymptomatic or experienced mild disease may harbor the

parasite and develop severe symptoms years later, complicating diagnosis and posing an important health risk (Parise et al., 2014). In the same vein, Zoonotic parasitic infections often cause vague symptoms or trigger other disease processes, but the etiology can be difficult to prove. The presence of certain parasites has been tentatively linked with other diseases—for instance, *Toxoplasma* antibodies detected in individuals with mental illnesses, or *Toxocara* infections in people with asthma (Parise et al., 2014)—but these are currently correlative rather than causative links. Further research is necessary to determine the long-term health impacts caused by parasitic infections in people.

While not the primary focus of this project, it is important to note that socioeconomic factors play a role in risk of infection. Most NPIs disproportionately affect low-income communities with less access to healthcare and diagnostic services (Parise, et al., 2014). Unfortunately, these communities are also difficult to survey, likely skewing the current literature on parasitic prevalence.

Wildlife as Vectors of Zoonotic Parasites

As discussed above, the CDC's list of NPIs prioritizes toxocariasis, cysticercosis, and toxoplasmosis, but there are several other zoonotic parasitic species of import found in North American wildlife. Many of these parasites do not commonly spill over into human populations, but human infection carries severe consequences, so prevention is important. At the beginning of this project, my preceptor and I developed a list of parasitic species to include in my products. This list was based on the available literature and each species was selected based on prevalence in wildlife, risk of spillover into people, and/or impact of human disease. While parasitic transmission can be complicated, most zoonotic parasites in wildlife roughly fall into two categories: fecal-borne and meat-borne. The following tables outline the pertinent information regarding the parasites researched throughout the course of this project.

Table 1.1: Fecal-Borne Zoonotic Parasites in Wildlife

Scientific Name	Common Animal Hosts	Method of Zoonotic Transmission	Symptoms in People
Ancylostoma caninum	Wild canids (e.g., dogs, wolves, coyotes, foxes), wild felids (e.g., bobcats, cougars)	Transcutaneous (through the skin) transmission of larvae	• Snake-like, itchy rash, usually on lower limbs or buttocks • Blisters and swelling
Ascaris suum	Swine	Fecal-oral ingestion of eggs, which require 18 days to several weeks	• Cough • Abdominal pain or discomfort • Worms in stool

		to mature in the environment before becoming infective	
Baylisascaris procyonis	Dogs, raccoons	Fecal-oral ingestion of eggs, which require 2-4 weeks to mature in the environment before becoming infective	• Nausea, abdominal pain, fever, lethargy, enlarged liver • Inflammation and scarring of the eyes, loss of vision • Neurologic signs, such as: weakness, irritability, incoordination, loss of balance/coordination, seizures, altered mental status, coma
Capillaria hepatica	Rodents (most typical), rabbits, swine, wild and domestic carnivores (e.g., foxes, dogs, cats)	Fecal-oral ingestion of eggs, which require 6 weeks – 5 months in the environment to mature before becoming infective	• Persistent fever • Inflammation and enlargement of the liver, leading to failure in serious cases • Death
Echinococcus granulosus	Wild and domestic canids	Fecal-oral ingestion of eggs (immediately infective)	• Inflammation of the liver and lungs, leading to organ damage and failure • Fever, anaphylactic shock • Itchy rash
Echinococcus multilocularis	Wild canids (e.g., foxes, coyotes, wolves)	Fecal-oral ingestion of eggs (immediately infective)	• Abdominal pain or discomfort • Weakness and weight loss • Liver failure, blockage of the bile • May spread to lungs, spleen, and brain (rarely)
Giardia spp.[1]	Beavers, opossums, birds, dogs, cats	Fecal-oral ingestion of cysts (immediately infective).	• Stomach cramps, nausea, vomiting • Dehydration and fatigue • Gas • Greasy, stinky diarrhea that floats • Weight loss
Taenia multiceps	Wild canids (foxes, wolves, coyotes), dogs	Fecal-oral ingestion of eggs	• Loss of balance/coordination • Changes in behavior, loss of consciousness

		(immediately infective)	• Seizures • Death
Taenia serialis	Dogs, foxes	Fecal-oral ingestion of eggs (immediately infective)	• Lumps under the skin; generally painless, but may be tender. Lumps may cause further issues depending on their location (e.g., within the eyes)
Toxocara spp.	Wild and domestic canids (e.g., foxes, coyotes, wolves, dogs), wild and domestic felids (e.g., bobcats, cougars)	Fecal-oral ingestion of eggs, which require 1-4 weeks in the environment to mature before becoming infective	• Inflammation of the eye, vision loss • Coughing, pneumonia • Fever, fatigue • Abdominal pain, enlarged liver
Toxoplasma gondii	Wild and domestic felids	Fecal-oral ingestion of oocysts, which require 1-5 days in the environment to mature before becoming infective	• Swollen lymph nodes • Flu-like symptoms, muscle pain • Headaches and fatigue • Inflammation of the brain, eyes, or other organs • Fetal infections may result in serious eye or brain damage at birth or later in life • Ocular (eye) infections can result in reduced and/or blurred vision, eye pain, redness, and tearing

1. Zoonotic importance of *Giardia* spp. remains unclear.

Note: All information in the above table is adapted from parasite fact sheets published by the Centers for Disease Control and Prevention (CDC) for *Ancylostoma caninum, Ascaris suum, Baylisascaris procyonis, Capillaria hepatica, Echinococus multilocularis, Giardia spp., Taenia multiceps, Taenia serialis, Toxocara spp.,* and *Toxoplasma gondii.*

Table 1.2: Meat-Borne Zoonotic Parasites in Wildlife

Scientific Name	Common Animal Hosts	Methods of Zoonotic Transmission	Human Disease
Taenia solium	Swine	Ingesting raw or undercooked infected meat	• Abdominal pain • Loss of appetite, weight loss

			• Nausea • Proglottids in feces
Toxoplasma gondii	Most warm-blooded mammals	Ingesting raw or undercooked infected meat	Same as Table 1.
Trichinella spp.	Swine, bears, foxes, wolves, wild felids (e.g., cougars)	Ingesting raw or undercooked infected meat	• Nausea, vomiting • Diarrhea and abdominal pain • Headache • Fever, chills • Muscle and joint pain • Swollen eyes • Skin rash

Note: All information in the above table is adapted from parasite fact sheets published by the Centers for Disease Control and Prevention (CDC) for *Taenia solium, Toxoplasma gondii,* and *Trichinella* spp.

Urban Wildlife: Vectors of Zoonotic Disease

As illustrated by the tables in the previous section, infected wildlife species contaminate the environment with fecal-borne zoonotic parasites. While urbanization created environments detrimental to many animal species, resulting in declining populations due to a lack of appropriate habitats, other animals have adapted and even thrive in cities and suburbia. Animals such as raccoons, foxes, and squirrels are common neighborhood sights, but represent an under-recognized source of human exposure to zoonotic parasites (Mackenstedt et al., 2015).

Raccoons are an excellent example of how the behavior of urban wildlife contributes to environmental contamination with parasitic eggs. Raccoons are creatures of habit and select specific areas where they prefer to defecate. Unfortunately, raccoons carry the roundworm *Baylisascaris procyonis* and shed the immature eggs in their feces. *Baylisascaris* eggs are extremely hardy and can survive in the environment for months or even years, long after the latrine has been abandoned. In an urban or peri-urban environment, raccoon latrines may be found in barns, lofts, attics, chimneys, garages (Mackenstedt et al., 2015), or other similar spaces. If the microscopic eggs are accidentally ingested by a human, the parasite can cause severe neurologic or ocular disease (Centers for Disease Control and Prevention [CDC], 2019b). This parasite is just one example—urban wildlife carry several other zoonotic parasites (e.g., *Toxocara* spp.) and shed eggs in their feces, contaminating the environment.

Furthermore, urban residents often lack knowledge regarding wildlife and zoonotic disease. A survey conducted among residents (n=100) living in four different urban communities in Texas demonstrated that most of the surveyed individuals had a baseline understanding of raccoons and their behaviors, but very few were aware of the existence of *Baylisascaris procyonis.* Those that were aware did not know the details of transmission and human infection (Ogdee, Henke, and Wester, 2016). Individuals working in wildlife-centric fields consciously choose to interact with wildlife, whereas people living in urban communities may not realize

they are regularly exposed to wildlife and their pathogens. Thus, increasing awareness of zoonotic parasites in wildlife among communities would not only benefit those directly interacting with wildlife, but also the general public.

In summary, the adaptation of certain animal species to ever-changing habitats is remarkable but represents another potential source of human disease. This threat of human disease warrants a multifaceted public health response. However, the answer does not necessarily lie in the complete elimination of urban wildlife, but rather in the implementation of daily preventive practices and environmental management (e.g., safe removal of raccoon latrines). Further preventive measures and balancing human health and wildlife conservation will be discussed in later sections.

Domestic Pets: Perpetuating Parasitic Life Cycles

The previous section established the role played by wild animals in zoonotic parasitic transmission, but they are not the only source of potential human infection with zoonotic parasites. Domestic pets, such as dogs and cats, carry many of the same parasites, picking them up from the environment or through predation of small animals. Once infected, they shed eggs, larvae, or oocysts (depending on the parasite) into the environment, perpetuating parasitic life cycles and increasing environmental load.

Parasites in wildlife play an ecological role and may even be indicators of healthy biodiversity (Jenkins et al., 2015). However, parasites in domestic pets must be addressed due to their proximity to people, the potential for zoonoses, and the adverse effects on the animal's own health. According to the American Pet Products Association (APPA, 2025), 94 million U.S. households own a pet. Pets have a multitude of privileges that wild animals do not; they live in our homes, we handle their feces, and they may even sleep in our beds. Dogs, cats, and many other animals are rapidly integrating into human lifestyles and thus pose a unique risk to human health.

Dogs and cats generally contract parasites through predation of wildlife (meat-borne) or ingestion of animal feces (fecal-borne); once infected, they often shed eggs, larvae, or oocysts in their feces, contaminating the environment and potentially exposing people. While the majority of these parasites require time—ranging from days to weeks—to mature in the environment, once mature they can survive in the environment for months to years, long after the feces have decomposed. Thus, handling feces, especially older deposits, pose the greatest risk to human health. For instance, cats infected with *Toxoplasma gondii* shed oocysts (the immature parasite) in their feces, but the parasite requires 2-3 days to mature in the environment before it can infect another host (CDC, 2025a). This parasite is the reason why health professionals recommend against pregnant women cleaning litterboxes. However, this also means that regularly cleaning the litterbox greatly reduces the risk of exposure, since doing so removes the oocysts before they become infective.

Importantly, Americans do not commonly consume domestic pets. Thus, if strictly meat-borne parasites (e.g., *Trichinella* spp.) infect a dog or a cat, the animal cannot transmit them to people. However, while this is the case in the United States, dogs and cats do represent food sources in other countries, and in those instances, they do pose a risk of transmitting parasites like *Trichinella*.

Although an important consideration, the risk of human infection with zoonotic parasites from pets remains low, especially with the implementation of appropriate veterinary care and hygiene. Appropriate veterinary care includes routine physical exams, fecal tests for common parasites, and deworming based on those results. Simple steps can be taken to prevent human exposure, such as removing feces from the environment while fresh, scooping the litterbox, keeping cats indoors, and practicing hand hygiene after handling feces.

Conclusions on the Ecology of Zoonotic Parasites in Wildlife

As discussed above, human behaviors, urban wildlife, and domestic pets all contribute to the ecology of zoonotic parasites in wildlife. Its constant evolution is further driven by changing climates and expanding human populations, altering the human-wildlife interface and creating new opportunities for disease transmission. This section only provides a brief overview of an incredibly complex subject, but it sets the scene for the following cases, which will establish the consequences of human infection.

Transmission at the Human-Wildlife Interface: Analyzing Cases of Zoonotic Parasitic Infections in North America

The list of parasites outlined in a previous section were selected based on their presence in North American wildlife, the possibility of human transmission, and the severity of subsequent human disease. Some parasites, like *Toxoplasma gondii*, were included because the high number of human infections increases the likelihood of severe human disease in certain cases. Others, like *Echinococcus multilocularis*, rarely transmit to people, but have the potential to cause severe or even fatal human disease. The following sections cover select human cases of zoonotic parasitism, highlighting points of exposure and demonstrating the importance of preventive measures.

Trichinosis

Historically, commercial pork operations represented the major source of trichinosis infections. Today, with the implementation of targeted commercial management programs, *Trichinella* spp. infections have become rare in commercial pork products, subsequently reducing the number of human infections (Gamble, 2022). However, *Trichinella* spp. are alive and well in North American wildlife, resulting in several news-worthy spillover events.

In 2022, six cases of human trichinosis occurred following consumption of black bear meat containing *Trichinella nativa* larvae. Based on recommendations from a hunting outfitter in

Canada, the family froze the bear meat for 45 days to kill parasites (Cash-Goldwasser et al., 2024). While this might have killed *Trichinella spiralis,* the most common species found in pork, *Trichinella nativa*—a species that infects bears—is freeze-resistant (CDC, 2024c). This scenario, where nine family members gathered and shared bear meat cooked alongside vegetables, resulted in six cases of trichinosis, including two individuals who only consumed vegetables cooked and served alongside the undercooked meat (Cash-Goldwasser et al., 2024). In 2023, a similar scenario occurred in North Carolina when ten people exhibited symptoms of trichinosis after consuming bear meat. Trichinosis could not be confirmed in this case, but public health officials considered them probable cases based on clinical and epidemiological criteria (Gowler et al., 2024).

Trichinosis remains rare in the United States, but the majority of human cases are tied to consumption of wild game meat. These cases reveal several important features of trichinosis (and other parasites): freezing is an insufficient method of killing *T. nativa* (CDC, 2024c) and potentially other parasitic species, cooking wild game to an internal temperature of at least 165 degrees Fahrenheit is vital to kill parasites in meat (Cash-Goldwasser et al., 2024), and infection does not require direct consumption of meat, but rather may occur through cross-contamination.

Baylisascariasis

Unlike meat-borne parasites, such as *Trichinella* spp., fecal-borne parasites are commonly found in the environment. In general, parasitic infections are more common in children due to their tendency to put their hands in their mouth, lack of hand hygiene, and increased likelihood of eating dirt.

This tendency is evidenced by two cases of baylisascariasis that occurred in two children in California in 2024 (Vaughan et al., 2025). Although they occurred within the same county, the two cases were unrelated. The first case occurred in a 14-year-old previously diagnosed with autism and pica, whereas the second occurred in a 15-month-old child. Both cases resulted in neurologic changes secondary to eosinophilic meningitis, and both were treated with albendazole (an anti-parasitic medication), and corticosteroids. The second child also had a live intraocular nematode, which clinicians treated with laser ablation. While the first child returned to his baseline neurologic status, delays in diagnosis and treatment of the second child resulted in severe and persistent neurologic and ophthalmic sequelae. Investigation of their respective histories and environments demonstrated some differences: the first child not only had a history of pica, but investigators also identified a raccoon latrine on the property. In contrast, the second child did not have obvious exposure to raccoons or latrines, but the animals had been noted in their neighborhood, and the child was known to place soil and bark mulch into his mouth when outside (Vaughan et al., 2025).

These cases emphasize the severity, and thus the importance, of human infection with *Baylisascaris procyonis* and other zoonotic parasites. It also highlights how suburban wildlife contributes to environmental contamination, leading to cases without an obvious point of

exposure (as in the case of the second child). Finally, accurate diagnosis and subsequent treatment of baylisascariasis is difficult due to the rarity of the disease, but delays result in severe consequences. Thus, improving awareness among the general public is important for prevention, and improving awareness among health professionals is vital for early diagnosis and treatment.

Toxoplasmosis

While many zoonotic parasites rarely infect people, approximately 11% of the U.S. population have been exposed to *Toxoplasma gondii* (Jones et al., 2018). Worldwide, evidence suggests that up to 60% of some populations have been infected (CDC, 2025). Although widespread, *T. gondii* only causes clinical disease in a small percentage of infected individuals. However, immunocompromised individuals can develop potentially fatal encephalopathy, and fetal infections may result in severe congenital neurologic defects or ocular infection, stillbirth, or miscarriage (Montoya and Liesenfeld, 2004).

Cases of toxoplasmosis most commonly occur in people who consume undercooked wild game or contaminated water or soil. In 2018, six hunters (out of a group of ten) became ill after eating undercooked deer meat at a hunting retreat held in Illinois. Two of the asymptomatic hunters were already immune to toxoplasmosis (Gaulin et al., 2020). One outbreak in Victoria, British Columbia, Canada had far-reaching consequences—experts suspect that contamination of Victoria's watershed with cougar and domestic cat feces likely led to the 1994 outbreak of toxoplasmosis (Aramini et al., 1999). These outbreaks of toxoplasmosis demonstrate the ecological factors contributing to human infection. Like trichinosis, consumption of undercooked wild game poses a risk of transmitting *T. gondii*, especially since the parasite thrives in a wide range of species. Furthermore, the outbreak associated with the contaminated watershed illustrated the importance of appropriate water treatment methods and the potential for far-reaching consequences when community resources are contaminated.

Fetal infection also carries severe consequences. Marrakchi et al. (2024) presents one such case, where fetal toxoplasmosis resulted in microcephaly (small cranial circumference) secondary to neurologic damage that led to a reduction in brain tissue. The mother reported an uneventful pregnancy with no known source of exposure, but the baby was diagnosed based on serial serology as a newborn. The attending clinicians implemented a year-long antimicrobial protocol (Marrakchi et al., 2024). The long-term clinical progression and prognosis of this child were not discussed, but neurologic damage of this level would have long-term implications.

Although some cases of toxoplasmosis can be traced back to a specific source, many people with positive titers have no recollection of when they might have been exposed. In one study conducted among mothers of babies born with congenital toxoplasmosis, only 49% could identify potential risk factors associated with infection (Boyer et. al., 2011). The ubiquity of this parasite and high global prevalence make prevention difficult, but the potential for severe infections, especially in fetuses, necessitate preventive practices.

Toxocariasis

Due to the high numbers of dogs and cats in North America, *Toxocara canis* and *Toxocara cati* are relatively ubiquitous in U.S. soil, and these parasites are responsible for the highest number of human helminth infection in the United States (Bradbury, 2020). Wild canids and felids also carry this parasite and shed eggs in the environment, perpetuating the life cycle and contributing to human disease. The seroprevalence of *Toxocara* spp. in the U.S. is roughly 5%, but the risk of seropositivity is 80-90% higher for those living in poverty as compared to those living above the poverty line (Inagaki et al., 2019).

Inagaki et al. (2019) describe three cases of probable ocular toxocariasis that occurred in the Mississippi Delta, a rural community with high rates of poverty. All three presented for visual impairment and were tentatively diagnosed based on clinical findings after ruling out other causes, but definitive diagnoses could not be obtained. Two out of the three cases experienced a permanent decrease in long-term visual acuity.

Toxocara spp. infections may also result in visceral larva migrans (VLM), which occurs when the immature parasite travels throughout the host's internal organs. This form can be fatal, as demonstrated by Wygant and Cohle's (2023) case report involving a 19-month-old child. The child was found dead after experiencing upper respiratory signs for several days. However, postmortem autopsy and diagnostics confirmed infection with *Toxocara cati*, manifesting as fatal myocarditis and hepatitis. In this case, the patient likely contracted toxocariasis from the family's cat. This case also occurred in a lower income household.

Although these cases are not specifically tied to wildlife (exact points of exposure were not identified in the cases of ocular toxocariasis), they demonstrate the severity of potential disease and the role played by socioeconomic status. Furthermore, both wildlife and domestic pets contribute to the environmental load of *Toxocara* spp. and increase the risk of human exposure.

Conclusion of Cases

The above cases illustrate that, while generally rare, the consequences of human infection with zoonotic parasites may have severe, long-term, or even fatal consequences, warranting intervention. However, educating the public and implementing evidence-based preventive measures can protect human health.

Best Practice Guidelines for Preventing Zoonotic Parasite Transmission from Wildlife to Humans

Although parasitic life cycles are complex, modes of transmission can be split into two broad categories: fecal-borne and meat-borne. Using these categories as a framework, zoonotic parasitic infections can be prevented with several relatively simple measures.

Fecal-Borne Parasites

This category is by far the largest, composed of parasites that reside within the gastrointestinal tract and shed eggs, larvae, cysts, or oocysts in their host's feces. A small number of these parasites are immediately capable of infecting a new host once shed (e.g., *Giardia spp.*), but most require some degree of time, ranging from days to weeks, to mature in the environment before they can infect other animals or people. Thankfully, there are several preventive measures available, based on the available literature and the points of transmission as discussed throughout this chapter:

- **Hand Hygiene:** Washing your hands with soap and water is the most effective method for removing parasite eggs, cysts, oocysts, or larvae. The Centers for Disease Control and Prevention (CDC, 2024b) outlines specific instructions for handwashing, recommending vigorous scrubbing for at least 20 seconds. Hand sanitizers containing at least 60% alcohol may be used when water is unavailable but are less effective against certain pathogens and may be ineffective in the presence of gross debris (CDC, 2024d).
- **Environmental Awareness:** As emphasized throughout this chapter, environmental contamination is one of the most common ways people are exposed to zoonotic parasites. Avoid areas that may contain a high parasitic load (e.g., raccoon latrines) and practice hand hygiene after spending time outdoors.
- **Parasites in Pets:** As extensively discussed in a previous section, some species of parasites from wildlife infect dog and cats. The Companion Animal Parasite Council (CAPC, 2025) recommends routine physical exams, regular fecal testing, year-round flea, tick, and heartworm prevention (many of which also kill common intestinal parasites), and deworming based on testing results. These measures, performed under the supervision of a veterinarian, can decrease the environmental parasite load, and thus decrease risk of human exposure.
- **Fecal Removal:** Identifying animal feces and removing them decreases the environmental load, especially if conducted before the parasites have matured enough to infect a new host (varies depending on the parasite). Scoop litterboxes daily and clean regularly. Pick up your dog's feces on walks and in the backyard. If handling wildlife feces, such as when cleaning raccoon latrines on your property, follow the Center for Global Health's (2011) recommendations for safe removal.
- **Wear Shoes:** While most parasites require ingestion to infect people, *Ancylostoma caninum* can penetrate through the soles of bare feet and cause a migratory rash (CDC, 2019g). Wearing shoes decreases the risk of infection.
- **Watch Children:** As demonstrated by the discussed cases of baylisascariasis (Vaughan et al., 2025), children are more likely to accidentally ingest parasitic eggs than adults. Prevent children from eating dirt or placing leaves, bark, or

other potentially contaminated items in their mouths. Teach older children how to appropriately wash their hands after playing outside and before eating.

Meat-Borne Parasites

This category includes a smaller, but still significant, group of parasites. Zoonotic infection occurs when an individual consumes raw or undercooked meat infected with the parasite. The most classic example of this is *Trichinella spp.,* as discussed in a previous section. Thanks to the presence of urban wildlife, most people are at risk of exposure to fecal-borne parasites. Meat-borne parasites, specifically those carried by wildlife, affect a much smaller group of people: hunters, trappers, and those that consume wild game. There are several ways to prevent zoonotic transmission of these parasites:

- **Hand Hygiene:** Wear disposable gloves when handling the carcass and preparing the meat. Wash your hands with soap and water after handling or processing the carcass and often during the cooking process. Cross-contamination alone can result in infection, as illustrated by a previously discussed case (Cash-Goldwasser et al., 2024).
- **Cooking:** Cook wild game to a minimum internal temperature of 165 degrees Fahrenheit. This method is the only reliable way to kill parasitic cysts (Gowler et al., 2024). This can be easily achieved by using a meat thermometer to measure the temperature within the thickest part of the meat. Other methods, such as freezing, drying, curing, or smoking, are unreliable methods of killing *Trichinella* spp. (CDC, 2024c).
- **Cleaning:** Clean countertops, cutting boards, and dishes used during preparation and cooking with warm, soapy water as you go to prevent reintroducing the parasite to the cooked meal.

As previously discussed, parasites are a natural part of wildlife and the environment. There are steps we can take to prevent human disease, but as long as there are wild animals, there will be parasites with the potential for zoonoses. This statement leads us into our next topic—the ever-changing balance between humans, animals, and the environment.

Wildlife and One Health: Balancing Public Health and Wildlife Conservation

Public health, by definition, is anthropocentric. The field focuses on preventing disease in people, promoting individual and community health, and prolonging human life (Winslow, 1920). Public health acknowledges the importance of various factors within greater systems, from socioeconomic factors to environmental ones, and analyzes and manipulates these systems to better human health. Similarly, One Health is based on the idea that the health of people, animals, and the environment are inextricably intertwined. In contrast to public health, however, One Health prioritizes the health of all three, operating under the idea that by improving one, you

improve all. One Health is meant to be an interdisciplinary field, enlisting the knowledge of public health experts, medical doctors, veterinarians, environmental scientists, and a variety of other fields. In reality the concept is currently most implemented in the veterinary and public health fields and still prioritizes human health over environmental and animal health (Jenkins et al., 2015).

Zoonotic parasites in wildlife present a public health challenge. Wild animals are important reservoirs of disease, but they also play vital ecological roles. As Jenkins et al. (2015) state in their article on wildlife parasitology and One Health, "Wildlife are frequently considered in One Health contexts as reservoirs of emerging diseases that threaten human health or food security, and not as fellow inhabitants of a changing environment with shared risks" (p. 175). This perspective contributes to the perception that wild animals are simply a source of disease rather than vital species deserving of preservation. This point of view emphasizes the risk of "spillover" of pathogens from wildlife to people, ignoring the human behaviors and environmental changes that contribute to such spillover events. Furthermore, parasites are ubiquitous in wildlife and this fact is not uniformly bad—in fact, the presence of parasites in wildlife may indicate higher levels of biodiversity and may imply a healthy ecosystem (Jenkins et al., 2015). It stands to reason that the answer is not eliminating parasites from wildlife or eliminating wildlife. Doing so could upset natural ecosystems and instead lead to new, unforeseen disasters, both environmental and pathogenic in origin, leading to detrimental effects on human health. Instead, participants in One Health movements should focus on understanding the human behaviors, environmental conditions, and wildlife factors that contribute to spillover events to identify points for intervention.

Methods of communicating risk also play an important role when educating the public. In the context of wildlife parasitology, care must be taken to prevent the demonization of wildlife when discussing the importance of zoonotic parasites. This balance can be difficult to find; as Decker et al. (2011) states in their article on strategic communication regarding zoonotic diseases in wildlife, "In the risk-averse society of the United States, EID [Emerging Infectious Disease] events associated with wildlife have the potential to diminish the value of wildlife for society, depress interest in wildlife-related activities and decrease support for wildlife conservation" (p. 118). Decker et al. (2011) goes on to urge wildlife professionals to involve themselves in the public framing of wildlife disease and advocate for wildlife, or the issue may be communicated by the public health field in such a way that negatively impacts conservation. This article emphasizes the importance of interdisciplinary collaboration between wildlife professionals, veterinarians, and public health experts when educating the public and highlights the importance of clear, evidence-based communication. Combining multidisciplinary perspectives ensures the accurate portrayal of the disease risks posed by wildlife while promoting achievable interventions and preserving the value of wildlife.

Parasitic diseases are under-studied in wildlife. One Health motivates further study and surveillance of zoonotic parasites in wildlife, benefiting both wildlife-centric and public health

fields. Understanding wildlife behavior, environmental factors, and the true prevalence of zoonotic parasites in wild animals would provide useful information that can then be used to further guide preventive efforts.

Conclusions

Zoonotic parasitic diseases in wildlife remain a poorly characterized threat in North America, exacerbated by the higher prevalence of human parasitic disease in low resource communities with decreased access to healthcare, the vague or asymptomatic nature of human infection, and the many diagnostic limitations that exist. These issues necessitate further research regarding the true prevalence of zoonotic parasites in wildlife and in the general public.

Chapter 2 – Learning Objectives, Portfolio Products, and Competencies

This chapter outlines the key learning objectives and competencies achieved throughout the APE, summarizes the APE itself, and introduces the portfolio products. Together, these materials translate evidence-based knowledge into accessible resources, providing opportunities for real-world application.

Learning Objectives

The author's APE sought to achieve the following learning objectives:

1. **Academic Literacy:**
   Analyze current literature surrounding zoonotic parasitology and become conversant on an academic level. Identify relevant zoonotic parasites in wildlife, review cases of human infection, and compile a list of evidence-based preventive measures.
2. **Veterinary Parasitology and Client Education:**
   Develop knowledge regarding zoonotic parasites in wildlife, including those that may infect household pets. Discuss client education regarding zoonotic parasites with Dr. Herrin.
3. **Research and Writing Skills:**
   Refine research methods and learn to translate academic sources into accessible resources.
4. **Public Health Materials:**
   Express important public health themes through both written and visual resources to improve accessibility to non-academic audiences and broaden understanding of important public health issues.

Project Description

While North American society has largely shifted away from reliance on subsistence hunting, wildlife-centric activities, such as hunting, trapping, and conservation, remain an important part of many people's lifestyles, representing potential avenues for zoonotic disease transmission. According to the U.S. Fish and Wildlife Service, over 14.4 million Americans hunted wildlife in 2022 (U.S. Fish and Wildlife Service, 2024). Furthermore, urbanization and multiplying human populations increase the possibility of unintentional or indirect interactions between people and wildlife. This evolution affects both human and animal behaviors—as urban populations explode, the number of Americans participating in outdoor recreation has also trended upwards, especially since the 2020 COVID-19 pandemic. In 2023, 175.8 million Americans participated in outdoor recreation (Outdoor Foundation & Outdoor Industry Association, 2024). Similarly, wildlife populations have scrambled to adjust to the rise in

concrete jungles, with some species adapting to life in the city while others are forced to retreat to the shrinking expanses of wilderness, closing the gap between humans and animals and increasing points of contact along the human-wildlife interface. Such contact precipitates transmission of infectious diseases, including zoonotic endoparasites (hereafter referred to as "parasites"), sometimes causing severe human disease.

As extensively discussed in Chapter 1, wild animals carry a wide variety of zoonotic parasites, with cases of human infection documented throughout the literature. While there are gaps in the literature regarding true prevalence of zoonotic parasites in both wildlife and people, there is an abundance of information on general transmission, signs of illness, and prevention. The Centers for Disease Control also publishes disease-specific pages summarizing this information, designed to provide resources to the general public. However, a specific compilation of zoonotic parasites in wildlife, geared toward those working directly with wildlife, did not exist. Thus, the idea for an evidence-based, best practice manual covering zoonotic parasites in wildlife was born. This idea resulted in the first product, as described in the following sections.

Zoonotic Endoparasites in Wildlife

In the initial stages of the project, I worked with Dr. Brian Herrin, a board-certified veterinary parasitologist and my preceptor, to identify the target audience: hunters, trappers, wildlife rehabilitators, and anyone else who works with wildlife in a non-academic setting. From here, we created a prioritized list of endoparasites in North American wildlife, selected based on their prevalence, severity of human infection, or potential for long-term disease. In general, common parasites were included due to the higher likelihood of human infection, whereas more rare species were included based on the severe consequences related to infection.

I researched, wrote, and formatted 2-4 pages of information regarding each parasite. I divided the pages into short sections, focused on communicating key information in a concise, accessible manner. Each document begins with a short summary of the parasite, including its common and scientific names as well as the disease and symptoms it causes in people. The headings are enhanced with drawings I created of the featured parasites and animal hosts. The next portion outlines the parasite's life cycle, emphasizing the potential points of transmission. Finally, each section ends with applicable preventive recommendations and a list of relevant animal hosts.

This organization is purposeful; by introducing the parasite and immediately emphasizing the consequences of human infection, each section establishes the importance of disease before exploring the details of transmission and prevention. This manual is not written to scare people or discourage them from working with wildlife, but rather to implant an understanding of the gravity of zoonotic disease before providing them with tools to protect themselves. Furthermore, individuals are more likely to implement preventive measures if they understand why those measures are necessary, highlighting the importance of providing contextual information.

Multimodal Materials

The information within each section is presented in three different ways: narrative paragraphs, bullet points, and visual materials. There is some overlap between these materials to emphasize certain points; for instance, I designed a life cycle for each parasite and paired this visual with focused bullet points that emphasize pertinent parts of the life cycle, such as how people become infected and how the parasite causes disease. These overlaps serve to present the same, vital information in different ways to increase understanding and reader retention.

Parasitic Prevention Practices

The desired outcome of this project is to prevent zoonotic parasitic infections in people by providing applicable preventive methods. Once I established importance of parasitic infections and how they infect people in the first few paragraphs of each section, I provided a list of preventive practices tailored to each parasite.

In general, endoparasites can be divided into two main categories: fecal-borne and meat-borne. Fecal-borne parasites generally reside in the gastrointestinal tract and shed eggs, larvae, or oocysts into their host's feces. Meat-borne parasites reside within the host's muscles, necessitating consumption to precipitate human infection. Each section contains specific preventive recommendations based on the individual parasite's life cycle.

Wildlife Magazine

For the second product born out of my Applied Practice Experience, I wrote an article for the *Wildlife Professional*. This article served as another way to relay the most important components of this project to a slightly different audience: wildlife professionals, inclusive of a mixed academic and non-academic audience. The article opens with a narrative story before focusing on fecal-borne versus meat-borne parasites and preventive practices for each.

Conclusion of Products

Together, these products provide two resources that bridge the gap between academic literature and accessible information. They reflect the knowledge gained through thorough research and apply concepts learned throughout the MPH coursework. They also achieve several MPH competencies, which will be discussed in Chapter 4.

Chapter 3 – Reflection and Lessons Learned

I produced several portfolio products designed to communicate key concepts regarding zoonotic endoparasites in wildlife to the target audience. The APE yielded two main products: a comprehensive body of work describing the life cycles, modes of transmission, and preventive recommendations for 13 different species of zoonotic parasites in wildlife, and a commentary article summarizing the key points of the manual, focusing on broad categories of zoonotic parasites and general recommendations for prevention.

Project Reflection

Bridging Communication Divides Between Academic Literature and the Public

This portfolio contributes several resources to the fields of public health and parasitology, including visual life cycles, condensed information regarding the ecology of zoonotic endoparasites in wildlife, applicable preventive recommendations, and a commentary article summarizing the key points of this topic. While public resources regarding a wide variety of zoonotic parasites exist online (such as through the CDC's website), the portfolio consolidates the information specifically relevant to zoonotic endoparasites in wildlife into two products accessible to the target audience. Furthermore, the products draw on scientific studies, requiring accurate translation of scientific jargon into language understood by the general public.

By doing so, the portfolio fills an existing informational gap in the public health and wildlife fields. The manual will eventually be completed with further sections on ectoparasites and general preventive strategies and will be available in an online format. Similarly, the commentary article will be submitted for future publication in the *Wildlife Professional*. Together, these products will increase public awareness of zoonotic disease and give hunters, trappers, biologists, and conservationists the tools to protect themselves.

Acknowledging Project Limitations

The information covered in this portfolio is based on informational pages found on the CDC's website and the available literature for each species. However, data on the prevalence of many zoonotic parasites in wildlife and in people is limited. Much of the available literature is comprised of isolated case studies or studies with small sample sizes, and very few of these studies focused on the efficacy of specific preventive strategies. Thus, by necessity, many recommendations were logically made based on similar situations in other health spheres. While there were no specific studies on each of the zoonotic parasites in wildlife, hand sanitizer is described as ineffective for certain parasites such as *Cryptosporidium* spp., so I cautioned the audience against relying on hand sanitizer to kill parasites (CDC, 2024d). While this recommendation makes sense, care must always be taken when extrapolating data. The lack of scientific studies on the prevalence of zoonotic parasites and the efficacy of preventive strategies limits our understanding of best-practices regarding zoonotic parasites in wildlife.

Noteworthy coursework

The coursework completed in pursuit of my MPH provided the skills and knowledge necessary to conduct my APE and write my ILE. One of my elective courses, Veterinary Parasitology (VDMP 834), thoroughly covered zoonotic parasites in domestic animals, many of which also infect wildlife. This course discussed parasitic life cycles and why they matter, laying the foundation for my entire portfolio. I carried this knowledge with me throughout the duration of my project and continue to use my notes in my veterinary career.

Environmental Health (MPH 802) also directly impacted my understanding of zoonotic parasites in wildlife. This course encouraged systems thinking and explored the complexity of environmental health, including the factors leading to zoonotic disease transmission, host responses to disease, and strategies for managing or preventing infectious disease.

Finally, Multidisciplinary Thought and Writing (DMP 815) emphasized the importance of clear, concise communication. I have applied the techniques I learned through this course to all aspects of my portfolio. Overall, the MPH coursework not only prepared me for my APE, but it also provided skills and knowledge that I can use for the rest of my public health career.

Personal Reflection

Effective Communication: Translating Scientific Knowledge into Accessible Resources

As a veterinarian and a public health professional, I have spent years rewiring my brain to understand complex biological systems, communicate using appropriate scientific terminology, and design both treatment and prevention plans based on my accumulated knowledge. The veterinary portion of my education especially honed my scientific abilities, but my public health experiences emphasized the importance of clear communication.

Prior to this portfolio, I had a strong interest in parasitology, but I had little experience with wildlife and its associated professions. This APE prompted me to explore other experiences so that I can make appropriate recommendations. While my recommendations themselves are based on solid scientific resources, I also spent hours reading websites and watching videos on hunting, learning how to field dress a carcass, tan a hide, or prepare the meat. These resources gave me a window into another experience and allowed me to identify points of transmission, understand the measures some hunters and trappers already take to protect themselves (e.g., wearing gloves), and pinpoint the fragments of misinformation mixed into popular online resources.

Despite all this research, there were times where I struggled to “translate” information, especially regarding complex parasitic life cycles, into an accessible format without compromising key information. Each section required a delicate balance of providing enough contextual information to establish risk and inform recommendations while avoiding an overwhelming amount of new information. I settled on including detailed, visual life cycles, with

each step labeled, accompanied by bullet points emphasizing key points of transmission. This way, the information is there for those who require more detail, whereas those who need concise summaries can consult the bullet points. Similarly, I found myself unwittingly using medical terminology—for example, I originally listed "ataxia" as a symptom of baylisascariasis—requiring careful proofreading of each section (coupled with consultation with non-medical family members) to ensure accessibility.

Even after the completion of this APE, I continue to learn and implement effective communication strategies through my job as a veterinarian and my role as a public health professional.

Personal Application: Client Education in Veterinary Medicine

While this project focused on communicating the risks of zoonotic parasites in wildlife to the populations working with said wildlife, it also created pathways for communication with veterinary clients. I began this project between my second and third years of veterinary school; up until that point, my experience was largely academic. I had the textbook knowledge of a multitude of veterinary diseases, including parasitic ones, but I did not yet have the experience of communicating with clients.

Researching and creating the content for the parasite manual solidified my understanding of zoonotic parasites. Furthermore, this project taught me to think through complex topics and translate them into terms understood by different groups of people.

Since graduating and starting my first job as a veterinarian, this skill has served me well. Not only do I translate complicated concepts to clients on a daily basis, I utilize the knowledge I gained through this project. I have had discussions with owners regarding raw meat diets and why certain methods, such as freeze-drying, do not reliably kill parasites in meat. I've discussed the importance of regular fecal testing and deworming with owners who take their dogs hunting every season. I've talked through parasitic life cycles with owners to provide context and support for my recommendations and communicate zoonotic risk when appropriate.

Altogether, the skills I gained through the completion of this APE have already improved my client communication skills and these skills will continue to grow and improve as I practice veterinary medicine and public health.

One Health: Balancing Public Health and Wildlife Conservation

On a final note, as both a veterinarian and public health professional, I am invested in improving the health of both animals and people through One Health initiatives. I believe that environmental, animal, and human health are inextricably intertwined. In the context of wildlife, "health" may look very different than it does for domestic pets and for people, and there is the added human dynamics of hunting, trapping, and conservation, creating avenues for zoonotic spillover events. As extensively discussed in an earlier section, parasitism in wildlife is a normal component of their ecology and is unlikely to be eliminated (and potentially should not be).

Instead, I mediate these interspecies relationships by identifying and counteracting points of disease transmission. The goal is to improve the safety of those working with wildlife, rather than preventing them from interacting with wildlife at all. These concepts can also be applied in veterinary medicine—as demonstrated by the fatal case of *Toxocara cati* in a child, our own pets are capable of transmitting deadly diseases to us, but this possibility does not make owning pets inherently dangerous or wrong. Instead, it emphasizes the importance of appropriate hygiene, veterinary care, and owner education to prevent tragic cases like this.

The way in which we, the experts, communicate about zoonotic disease directly affects how individuals view animal species and may dictate actions they take. If pregnant women are simply told cats carry a dangerous parasite and can transmit a fatal disease to their baby, they may choose to get rid of their cat. However, if appropriately educated regarding the risks of toxoplasmosis and how to avoid exposure, they can keep their family pet and protect their child's safety. Similarly, if we only tell one side of the story—that wildlife carry deadly diseases—without also offering individuals the contextual information to understand risk and tools to prevent disease transmission, we simultaneously discourage hunting (an important form of population control) and conservation (by demonizing endangered or at-risk species).

If we only protect human health today, at the expense of environmental and animal health, we forego the *future* of human health. Instead, caring for the long-term health of people, animals, and the environment requires a multidisciplinary approach that focuses on preventive strategies.

Future Research and Applications

The conversation surrounding zoonotic parasites in wildlife does not end here. Instead, the extensive research revealed a myriad of questions and areas for further research. Due to the vague nature of parasitic disease and the complex diagnostics required, one over-arching question can be applied to almost all of these zoonotic parasites: what is the true prevalence of human infection, and what unknown consequences does human infection carry? In the same vein, are occult human parasitic infections contributing to the pathophysiology of other diseases more than currently recognized? Moreover, as the environment continues to evolve, fueled by expanding human populations and urbanization, will we see an increase in zoonotic parasitic spillover events? Will we see human infections with parasites previously thought limited to animals? Are there parasites in wildlife in danger of becoming extinct, and are there ecological reasons to preserve these parasites?

These questions reinforce the need for further research. Surveillance of human parasitic infections is largely based on serologic evidence, but these methods are limited; serology does not always confirm active infection, and individuals with chronic, localized disease (such as the cases of ocular toxocariasis discussed earlier) may be negative on serology. Similarly, the communities experiencing higher rates of exposure and infection tend to be rural and under-resourced, thus rendering surveillance more difficult. Finally, surveilling the prevalence of

parasites wildlife in general proves difficult due to the lack of funding for such endeavors and the indirect nature of diagnosing parasitic infections (e.g., fecal examinations or serologic tests).

Despite these questions, these portfolio products used the available information to collectively improve public education on the signs, symptoms, and modes of transmission of zoonotic parasitic diseases. While the main goal is to prevent exposure, they may also help individuals recognize potential exposure and symptoms of infection, which they can subsequently report to their healthcare providers, expediting accurate diagnosis and treatment.

This portfolio focused specifically on endoparasites in wildlife. Future goals for the wildlife manual include the addition of sections detailing the zoonotic risks, life cycles, and preventive measures for ectoparasites found in wildlife, as well as a section summarizing general preventive practices in greater detail. These sections may be completed by myself or another public health professional in the future. Other potential areas for application of this information include adaptation for veterinary use in both the wildlife and domestic veterinary fields. This information may prove beneficial to veterinarians and veterinary clients alike. Medical professionals could also benefit from continuing education on this topic to improve pattern recognition and prompt diagnostic screening of individuals with documented exposure to wildlife.

Overall, this portfolio offers accessible resources to people working with wildlife, while highlighting areas for further research and improvement with the goal of improving public health.

Chapter 4 – Competencies

Student Attainment of MPH Foundational Competencies

Table 4.1: Summary of MPH Foundational Competencies

Number and Competency		Description
7	**Planning and Management to Promote Health**	Assess population needs, assets and capacities that affect communities' health.
16	**Leadership**	Apply principles of leadership, governance, and management, which include creating a vision, empowering others, fostering collaboration, and guiding decision making
18	**Communication**	Select communication strategies for different audiences and sectors
21	**Interprofessional and/or Intersectional Practice**	Integrate perspectives from other sectors and/or professionals to promote and advance public health
22	**Systems Thinking**	Apply systems thinking tools to a public health issue.

This portfolio represents an evidence-based approach to communicating best practice preventive strategies for zoonotic endoparasites in wildlife to a largely non-academic audience. The following sections demonstrate how the portfolio fulfills several select foundational competencies.

Competency 7: Public Health Importance of Zoonotic Parasites in Wildlife

"Assess population needs, assets, and capacities that affect communities' health."

This portfolio endeavors to communicate the importance of zoonotic parasites in wildlife to the relevant audience. This project first required an understanding of the target population, their interactions with wildlife, and the environmental context. I, in partnership with my preceptor, identified the target audience as a largely non-academic one, inclusive of individuals that interact with wildlife through hunting, trapping, research, conservation, or rehabilitation. Other potential members of the audience include individuals who indirectly interact with

wildlife—whether by spending time outdoors or through chance encounters with suburban wildlife. Understanding the target audience and their needs provided the foundation for the entire project.

A review of online resources—including academic articles, public health websites, and news articles—revealed that while there is a library of information available on zoonotic parasites, it ranges from scientific resources inaccessible to the general public to sensational articles containing misinformation. Furthermore, while the information contained in the wildlife manual can also be found through accessible resources online, such as the Centers for Disease Control, as well as in resources like the National Wildlife Health Center's Field Manual of Wildlife Diseases (Franson et al., 2015), a concise compilation focusing on the most relevant zoonotic parasites in wildlife did not exist.

Competency 16: Empowering Individuals with Information and Applicable Action

"Apply principles of leadership, governance, and management, which include creating a vision, empowering others, fostering collaboration, and guiding decision making."

Leadership, in both the public health and veterinary fields, involves establishing the importance of the issue, appropriately educating the audience on key concepts, and making logical recommendations based on the provided information. By doing so, the audience receives contextual information that furthers their individual understanding of the issue and consequently increases their adherence to the recommended preventive practices.

Both products created throughout the course of this project embody this competency. Prior to making any recommendations, the wildlife manual sets the context by discussing the life cycles of each parasite, identifying points of potential transmission, and emphasizing the consequences of human disease. By doing so, the manual establishes the importance of zoonotic parasites in wildlife, their impact on human health, and why the audience should care. Each section concludes with applicable recommendations to prevent parasitic transmission.

Similarly, the wildlife magazine article highlights the consequences of human infection with zoonotic parasites, followed by straightforward methods of preventing infection. Both products draw the connections between parasitic life cycles and modes of transmission to logically support the recommended preventive practices. This approach educates the audience and allows them to evaluate the risk of disease, exercise their own critical thinking skills, and make informed decisions about their health.

Competency 18: Translating Academic Literature into Accessible Resources

"Select communication strategies for different audiences and sectors."

As previously discussed, the project resulted in two products designed for the target audience. The first product, the wildlife manual, targets a largely non-academic audience, inclusive of anyone interacting closely with wildlife: hunters, trappers, wildlife conservationists

or rehabilitators, or anyone spending a significant amount of time in the great outdoors. Based on this audience, the wildlife manual details basic information regarding each parasite, discussing the importance of human disease, and outlining parasitic life cycles with bullet points and pictorial life cycles. Each parasitic section concludes with a list of applicable recommendations. The manual strives to communicate important concepts in an accessible manner while preserving the scientific integrity of the information. This goal is achieved by establishing basic terminology for each parasite, describing potential symptoms of human disease in non-medical terms, and communicating information in multiple ways (e.g., the life cycle images are accompanied by bullet points summarizing key points) to further understanding.

The second product, a commentary article submitted for publication in the *Wildlife Professional*, is a succinct version of the wildlife manual written in a more casual style reflective of the magazine for which it was created. The audience for this product is similar to that of the manual, but more focused on wildlife professionals. Due to the short form required for magazine articles, the product categorizes zoonotic parasites into two main groups: fecal-borne and meat-borne. By doing so, the article still provides important context, supported by tables outlining the selected parasitic species, that informs the subsequent preventive recommendations. The article also utilizes bullet points and tables to condense information into an accessible format.

Competency 21: Integrating Perspectives from the Public Health, Wildlife, and Veterinary Fields

"Integrate perspectives from other sectors and/or professionals to promote and advance public health."

Throughout the course of this project, I interacted with and consulted individuals in the public health, wildlife, and veterinary fields. I worked closely with Dr. Brian Herrin, a veterinarian and a board-certified parasitologist, to outline and execute the wildlife manual and the magazine article. He and I worked together to select relevant zoonotic parasites in wildlife, choosing species based on their public health risk. While I reviewed the literature, compiled information regarding each parasite, wrote and formatted the input for the manual, and designed parasitic life cycles, Dr. Herrin periodically evaluated my work to ensure accuracy and applicability.

To further tailor the products toward the target audience, I met with Geriann Albers, the Furbearer Biologist for the Indiana Department of Natural Resources. Based on her experience with hunters, trappers, and other wildlife professionals, she reviewed and provided feedback on one of the completed sections of the manual, identifying inaccessible terminology or concepts and providing insight into alternative phrasing. I also spent time researching points of exposure the audience might encounter. I reviewed online videos, filmed by hunters and trappers, demonstrating carcass processing, including field dressing, skinning, and tanning.

Finally, my experience as a veterinary student (and now a veterinarian) provided yet another perspective. My veterinary education, specifically my second-year Parasitology course,

stressed the role played by domestic animals in zoonotic parasite transmission. Hunting dogs may become infected with many zoonotic parasites and serve as another potential point of human exposure. Domestic and feral cats also contribute to the spread of parasites, especially *Toxoplasma gondii.* Furthermore, the presence of urban wildlife also exposes family pets to parasites, highlighting the importance of parasite control in dogs and cats.

Altogether, these different perspectives shaped the products and emphasized the importance of working across disciplines.

Competency 22: Understanding the Complex Ecology of Zoonotic Endoparasites in Wildlife

"Apply systems thinking tools to a public health issue."

Disease is always a product of complex interactions between humans, pathogens, and the environment. Parasites are an excellent example of this; their complicated life cycles require a host (sometimes multiple) and specific environmental factors to continue. Furthermore, the presence of specific species of wildlife often dictates the presence of certain species of parasites, further influencing the level of risk to a given individual. We have some degree of control over these interactions. By understanding parasitic life cycles, identifying points of exposure, and implementing appropriate preventive recommendations, we can minimize the risk of human infection with zoonotic parasites.

The project's products fulfill this competency by discussing parasitic life cycles. The pictorial life cycles included within the wildlife manual are an excellent representation of parasites as participants in a larger system, including their animal hosts and how specific environments aid in their survival. Through accompanying bullet points, the life cycles emphasize points of contact between wildlife, parasites, and humans, resulting in human disease. The wildlife manual and the commentary article both analyze these specific points of contact and formulate curated recommendations for prevention of zoonotic parasitic transmission.

Within the human component of these interactions, there exists another system, composed of the different groups of people interacting with wildlife. The behaviors of hunters, trappers, conservationists, and other individuals working with wildlife influence the possibility of parasitic spillover. Public health recommendations, such as those within the products, also play an important role in determining human exposure to parasites. Finally, the presence of urban wildlife creates another avenue for zoonotic parasitic transmission, fueled by a lack of awareness in urban households regarding wildlife and the parasites they carry. As discussed previously, their pets also participate in this system and may act as vectors of disease. Thus, the recommendations within the products specifically target points of interaction within these systems.

Student Attainment of MPH Emphasis Area Competencies

Table 4.2: MPH Emphasis Area Competencies

MPH Emphasis Area: Infectious Diseases and Zoonoses		
Number and Competency		**Description**
1	**Pathogens/pathogenic mechanisms**	Evaluate modes of disease causation of infectious agents.
2	**Host response to pathogens/immunology**	Investigate the host response to infection.
3	**Environmental/ecological influences**	Examine the influence of environmental and ecological forces on infectious diseases.
4	**Disease surveillance**	Analyze disease risk factors and select appropriate surveillance
5	**Disease vectors**	Investigate the role of vectors, toxic plants, and other toxins in infectious diseases.

This portfolio explores the complexity of parasites in wildlife as infectious disease and zoonoses, fulfilling the listed competencies.

Competency 1: Pathogens/Pathogenic Mechanisms

"Evaluate modes of disease causation of infectious agents."

At the beginning of this project, I worked with Dr. Herrin to create a list of the most relevant endoparasites in North American wildlife. I further divided the parasites into two main categories based on their mode of transmission: fecal-borne and meat-borne.

For each parasite I included in the wildlife manual, I discussed the mechanism by which the parasite infects people, what animals may carry each parasite, and how individual parasitic life cycles contribute to disease transmission. I created visual life cycles that emphasize the importance of understanding transmission when implementing preventive measures. Furthermore, these life cycles demonstrated that not every parasitic life stage can infect people. For instance, many parasite eggs require time in the environment to mature before they can infect another animal or human. In the same vein, the specific life stage of the parasite also matters. The tapeworm *Taenia solium* causes two different disease processes depending on which stage—

the larvae or the egg—is ingested by the new host (CDC, 2019d). These concepts are thoroughly discussed for each featured parasite.

The wildlife article provided a more concise overview of these concepts, focusing on the categories of fecal-borne and meat-borne parasites and discussing preventive measures for each. I also included a table for each category, listing the parasite's scientific name, relevant wildlife hosts, and the symptoms of human infection.

This competency provided the foundation for this project and paved the way for preventive recommendations reflecting these two modes of transmission.

Competency 2: Host Response to Pathogens/Immunology

"Investigate the host response to infection."

The entire portfolio focuses on preventing human infection with zoonotic parasites from wildlife. This goal first requires establishment of the consequences of human disease—or, in fulfillment of this competency, the human host's response to infection. For each of the endoparasites included, the wildlife manual details the resulting disease and symptoms observed in people, presented in concise bullet points. Certain signs of disease are tied back to the parasite's behavior and the host's resulting response; for example, Cutaneous Larva Migrans occurs when the larvae of *Ancylostoma caninum* penetrate human skin. The larvae migrate within the skin and stimulate an immune response, resulting in a pruritic, serpentine rash (CDC, 2019g). This parasite is also an excellent example of how the life cycle dictates the type of disease it may cause.

Not all human parasitic infections result in identifiable disease. The manual also discusses the possibility of subclinical or asymptomatic parasitic infections in people. In these cases, while the parasite may not cause obvious clinical signs in all human hosts, they still pose a risk to immunocompromised or pregnant individuals, so prevention remains important.

Competency 3: Environmental/Ecological Influences

"Examine the influence of environmental and ecological forces on infectious diseases."

Zoonotic parasitic infections are dynamic and influenced by the animal species that carry them, the individual parasite's life cycle, the environments in which those animals live, and the ever-changing human-wildlife interface. While I could not address every aspect of the complex ecology of zoonotic parasites, I focused on the interactions between humans, wildlife, and the environment that could lead to infection.

The presence of parasitic species in an environment is often determined by the presence of their animal hosts. The manual assumes that, as wildlife enthusiasts in some form, the audience is aware of what species of animals they may interact with and can determine risk of exposure to the different parasitic species. Thus, the specific geographic presence of each animal

host is not covered within the portfolio. Instead, each section concludes with a list of potential animal hosts so that the reader may determine their risk of exposure.

On that note, it is important to acknowledge the nearly ubiquitous presence of wildlife. Throughout the portfolio, I highlight the importance of indirect contact with wildlife, especially when considering fecal-borne parasites. Many parasites do not require direct contact with the animal itself but rather contact with the host's feces or even surfaces contaminated with feces. Both portfolio products stress the importance of hand hygiene after handling soil or touching potentially contaminated surfaces (e.g., tree bark), since these environments can harbor parasitic eggs or cysts for weeks, months, or even years. The presence of urban wildlife further enhances the risk of indirect contact and especially exposes children and pets to zoonotic parasites.

The portfolio also addresses direct interactions with wildlife—mainly through the harvesting, cooking, and consumption of wildlife—and how those interactions contribute to human infections. Human behavior has the most direct effect on this mode of transmission, since in today's world individuals choose to hunt or eat wildlife, and the way they do so directly influences their chances of exposure (e.g., wearing gloves when dressing a carcass).

Altogether, these products strive to represent the complexity of the environmental forces and ecological landscape contributing to zoonotic parasitic infections, identifying points of spillover and detailing methods of preventing said spillover, all while presenting this information in a concise, accessible form.

Competency 4: Disease Surveillance

"Analyze disease risk factors and select appropriate surveillance."

The products do not directly address surveillance methods for zoonotic parasites, but the literature reviewed throughout the course of the project repeatedly discussed the many obstacles to accurate surveillance of zoonotic parasites in wildlife and in people. This lack of data is a worldwide issue, resulting in a dearth of information regarding the true prevalence of zoonotic parasitic infections in people. This gap in information is largely due to the vague symptoms caused by many parasitic diseases (leading to under- or misdiagnosis), difficulties in accurate diagnoses, and the fact that zoonotic parasites disproportionately affect lower resource communities, where they are less likely to be detected. This competency was also thoroughly discussed and satisfied through the required coursework.

Competency 5: Disease Vectors

"Investigate the role of vectors, toxic plants, and other toxins in infectious diseases."

This competency is satisfied by the very foundation of this Applied Practice Experience: the transmission of zoonotic parasites from wildlife to humans. "Wildlife" is inclusive of a wide variety of potential vectors, from raccoons to bears, and the exact role changes depending on the vector in question. Each parasitic species discussed in the wildlife manual is accompanied by a

list of potential animal hosts, and the importance of wildlife as vectors of disease saturates every page of both the wildlife manual and the magazine article.

It is important to note that insect vectors play an important role in the transmission of many zoonotic parasites as well, but these diseases were not included since the manual focuses on parasites transmitted directly from wildlife to people.

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Appendix 1: Commentary Article

The commentary article below will be submitted for publication in the *Wildlife Professional*.

Parasites at Play: Preventing Zoonotic Transmission of Parasites from Wildlife

When I was a kid, my dad kept a mint green 1970s Chevelle in the garage. My siblings and I would sneak into this car, perching on its dark green upholstery and taking turns steering the wheel and cranking the windows open. In our carelessness, the windows were often left open, and the car became an unintentional haven for family pets and wildlife—a cat birthed a litter of kittens on the passenger side's floor and eventually raccoon feces began to accumulate in the backseat. None of this deterred us; as the third child, I was often delegated to the backseat, and I distinctly remember brushing dried feces off the bench seat with my bare hands so that I could hang out while my older brother claimed the driver's seat. What I didn't know at the time is that raccoons, and many other domestic wild animals, carry zoonotic parasites (transmissible from animals to people) that can infect humans. While these infections are overall rare, they often bear extreme consequences, and one important mode of infection is through indirectly interacting with, handling, or consuming wildlife. Public perception of human parasitism varies, ranging from the belief that people in developed countries don't get parasites to the idea that *everyone* has parasites requiring "parasite cleanses" promoted by social media influencers. Regardless of the extreme, misinformation abounds, creating fear and a lack of understanding on how to prevent parasitic diseases in the first place.

Zoonotic parasites (transmissible from animals to humans) in wildlife can generally be split into two main categories: fecal-borne and meat-borne. These categories provide a framework for understanding transmission and implementing preventive practices tailored to the most common parasitic species.

Fecal-Borne Parasites:

Many parasites spend their adult lives within the gastrointestinal tract of people or animals, shedding eggs or larvae in their host's feces. Depending on the parasite, some of these offspring require time to mature before they can infect people but can then survive in the environment for months or even years, long after the feces have decomposed. The table below describes the most common zoonotic parasites found in North American wildlife.

Table 1: Fecal-Borne Parasites

Scientific Name	Common Animal Hosts	Symptoms in People
Ancylostoma caninum (Canine Hookworm)	• Dogs • Wolves • Coyotes • Foxes • Bobcats • Cougars	***Cutaneous Larva Migrans:*** • Snake-like, itchy rash, usually on lower limbs or buttocks • Blisters and swelling
Ascaris suum	• Swine	***Ascariasis:***

(Pig Roundworm)		• Cough • Abdominal pain or discomfort • Worms in stool
Baylisascaris procyonis (Raccoon Roundworm)	• Dogs • Raccoons	***Baylisascariasis:*** • Nausea, abdominal pain, fever, lethargy, enlarged liver • Inflammation and scarring of the eyes, loss of vision • Neurologic signs, such as: weakness, irritability, incoordination, loss of balance/coordination, seizures, altered mental status, coma
Capillaria hepatica (Rat Liver Worm)	• Rodents • Rabbits • Foxes • Swine	***Capillariasis:*** • Persistent fever • Inflammation and enlargement of the liver, leading to failure in serious cases • Death
Echinococcus granulosus, E. multilocularis (Dog Tapeworm, Fox Tapeworm)	• Foxes • Coyotes • Wolves • Bobcats (rarely)	***Alveolar Echinococcosis:*** • Abdominal pain or discomfort • Weakness and weight loss • Liver failure, blockage of the bile • May spread to lungs, spleen, and brain (rarely) ***Cystic Echinococcosis:*** • Inflammation of the liver and lungs, leading to organ damage and failure • Fever, anaphylactic shock • Itchy rash
Giardia spp.	• Beavers • Opossums • Birds	***Giardiasis:*** • Stomach cramps, nausea, vomiting • Dehydration and fatigue • Gas • Greasy, stinky diarrhea that floats • Weight loss
Taenia multiceps,	• Foxes	***Coenurosis:***

T. serialis	• Wolves • Coyotes	• Loss of balance/coordination • Changes in behavior, loss of consciousness • Seizures • Death • Lumps under the skin; generally painless, but may be tender. Lumps may cause further issues depending on their location (e.g., within the eyes)
Toxocara spp. (Canine/Feline Roundworm)	• Wild and domestic canines (e.g., foxes, coyotes, wolves) • Wild and domestic felines (e.g., bobcats, cougars)	***Toxocariasis:*** • Inflammation of the eye, vision loss • Coughing, pneumonia • Fever, fatigue • Abdominal pain, enlarged liver
Toxoplasma gondii	• Cats are the only species that harbor the adult parasite	***Toxoplasmosis:*** • Swollen lymph nodes • Flu-like symptoms, muscle pain • Headaches and fatigue • Inflammation of the brain, eyes, or other organs • Fetal infections may result in serious eye or brain damage at birth or later in life • Ocular (eye) infections can result in reduced and/or blurred vision, eye pain, redness, and tearing

Why does this matter? Because, while important, it's not as simple as avoiding animal feces—since these parasites can survive in the environment for so long, exposure can occur through contaminated soil, water, or surfaces. For example, raccoons carry a parasite, *Baylisascaris procyonis*, which can cause organ damage, blindness, and neurologic disease in people (Center for Disease Control and Prevention [CDC], 2019). Raccoons will preferentially defecate in specific areas, called "latrines", essentially producing an outdoor litterbox full of hardy parasites that persist for years following abandonment of the site. In a continuously urbanizing world, raccoon latrines can include rooftops, decks, woodpiles, attics, or even (as I experienced) the backseat of a car, bringing the risk of exposure quite literally to our doorsteps.

Furthermore, certain parasites can result in life-threatening or debilitating diseases. For instance, *Echinococcus multilocularis* is a type of tapeworm carried by foxes, coyotes, and dogs

that can rarely infect people. The parasite causes slow-growing tumors within the body that, over time, damage internal organs and structures, eventually leading to death if left untreated (CDC, 2024). Due to the vague symptoms caused by this disease, it is difficult to diagnose, with the estimated time from infection to disease and subsequent diagnosis ranging from 5-15 years (Casulli et al., 2025). This disease may be rare, but human infection carries severe consequences, highlighting the importance of preventing this disease.

Thankfully, there are several steps we can take to protect ourselves, including:

- **Hand Hygiene:** Wash your hands after any outdoor activity, such as gardening, hunting, or any other practice that involves handling soil or potentially contaminated surfaces (such as tree bark), and prior to handling or preparing food. Washing your hands with soap and water for at least 20 seconds is the most effective method for removing parasite eggs, cysts, or larvae from your hands. Hand sanitizer is ineffective due to the resilience of many parasitic eggs or cysts.
- **Wear Gloves:** Wear gloves when handling carcasses or furs, as they may be contaminated with parasitic eggs, cysts, or larvae. Do not touch your face or mouth. Wash your hands afterwards, even if gloves were worn.
- **Environmental Awareness:** Avoid areas that may contain a high parasitic load (e.g., raccoon latrines) and practice hand hygiene after any outdoor activity. Environmental contamination is one of the most common ways people are exposed to zoonotic parasites.
- **Wildlife Feces:** Learn to recognize animal feces and avoid when possible. If on or near high-traffic areas such as houses, playgrounds, or gardens, remove them from the environment as soon as possible. Many parasitic eggs require time to mature in the environment before they can infect people, so fresh feces pose a lower risk. Additionally, these measures help decrease the environmental load of parasitic eggs. The Center for Disease Control outlines instructions for cleaning up such areas, such as raccoon latrines, on their website (CDC, 2024).
- **Parasites in Pets:** Test your pets for parasites regularly and deworm as necessary under the supervision of a veterinarian. Many of the parasites found in wildlife can infect your pets, which may then infect you. This is especially important for hunting dogs, as they are more likely to be exposed to parasites in wildlife.
- **Protect Children:** Monitor small children when they play outside and teach older children how to appropriately wash their hands. Children are more at risk of infection than adults because they tend to put dirt or objects in their mouths or fail to wash their hands after playing outside.

Meat-Borne Parasites

The other main mode of transmission occurs when people ingest raw or undercooked meat infected with parasites. The most classic example of this in North America is *Trichinella*, a parasite that creates microscopic cysts in the muscles of its hosts. Prior to modern commercial regulations surrounding pork production, undercooked pork was the most common source of trichinosis in the United States. Today, *Trichinella* cases are rare in the U.S., but most cases that

do occur are acquired from consuming raw or undercooked wild game, specifically that of wild boar or bears. This parasite does not require direct consumption of the meat, either—there have been cases of trichinellosis in people who consumed vegetables served on a table previously contaminated with infected bear meat (Cash-Goldwasser et al., 2024)**.** Symptoms of trichinellosis range from mild flu-like signs to more severe disease that can, rarely, result in death.

Table 2: Meat-Borne Parasites

Scientific Name	**Common Animal Hosts**	**Human Disease**
Taenia solium	• Swine	***Taeniasis:*** • Abdominal pain • Loss of appetite, weight loss • Nausea • Proglottids in feces
Toxoplasma gondii	• Most warm-blooded mammals	Same as Table 1.
Trichinella spp.	• Swine • Bears • Foxes • Wolves • Wild felines (e.g., cougars)	***Trichinosis:*** • Nausea, vomiting • Diarrhea and abdominal pain • Headache • Fever, chills • Muscle and joint pain • Swollen eyes • Skin rash

Parasites like *Trichinella spp.* are notoriously difficult to kill. The parasitic larvae encapsulate themselves within muscle cells, commandeering the cells to provide protection from the host's immune system. Some species of *Trichinella* have also developed a resistance to freezing, rendering this an unreliable method of killing the parasite. In the same vein, curing, smoking, or drying meat do not consistently eliminate tissue parasites in general.

Fortunately, there are several ways we can prevent infection.

- **Carcass Handling:** Wear disposable gloves when cleaning or handling the carcass and preparing the meat. Thoroughly wash your hands afterwards, even if you wore gloves.
- **Cooking:** Cook wild game to a minimum internal temperature of 165 degrees Fahrenheit. This is the only reliable method of killing parasitic cysts (Gowler et al., 2024). Using a meat thermometer to measure the temperature within the thickest part of the meat ensures appropriate internal temperature.

- **Cleaning:** Clean countertops, cutting boards, and dishes used during preparation and cooking with warm, soapy water as you go to prevent reintroducing the parasite to the cooked meal.

Conclusion

As demonstrated by my experience as a child, many of us may be exposed to parasites without realizing it, emphasizing the importance of preventive practices, even in an urban setting. The human-wildlife interface is constantly evolving, and factors such as environmental contamination, the presence of urban wildlife, and the handling and consumption of wild game further increase our risk of exposure to zoonotic parasites. However, the purpose of this article is not to discourage the consumption of wild game or scare you away from the great outdoors. Instead, the goal is to arm you with the knowledge and preventive practices to safely interact with wildlife and the environment.

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Appendix 2: Wildlife Manual

The author contributed 10 sections—split into a combination of narratives, bullet-points, and visual materials—discussing over a dozen species of zoonotic parasites in wildlife to a larger manual, forthcoming. The sections are attached below.

Hookworms

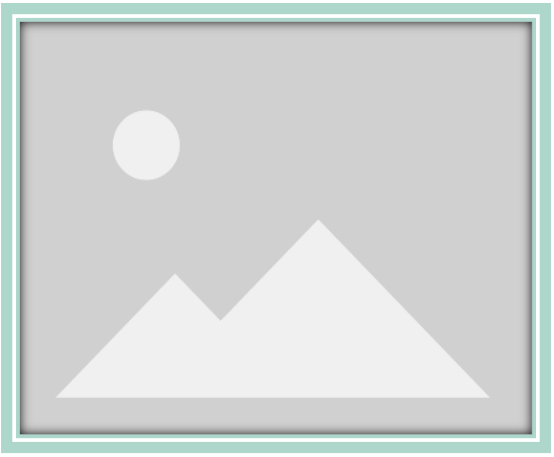
Ancylostoma braziliense, A. caninum,
Uncinaria stenocephala

WHAT IS CUTANEOUS LARVA MIGRANS?

Cutaneous Larva Migrans (CLM), also called Creeping Eruption, is a condition in people caused by several species of hookworms found in wildlife. While these hookworms commonly infect dogs and cats, they can also infect wild canines and felines, shedding eggs in their host's feces. People infected with these hookworms may experience the following symptoms:

- Snake-like, itchy rash on the lower limbs or buttocks
- Blisters and swelling
- Infection of the rash

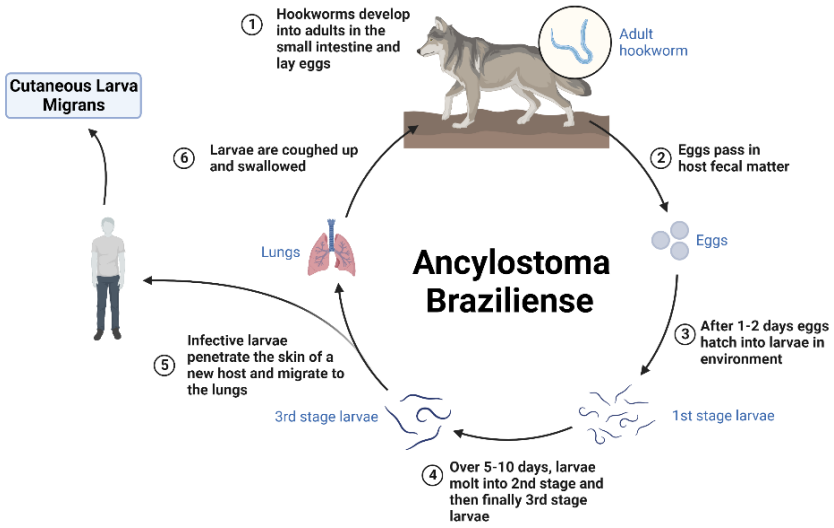
CLM generally heals on its own after 5-6 weeks, but complications such as bacterial infection of the rash may prolong recovery. It is important to seek medical treatment that can speed recovery and minimize the long-term effects of this parasite.



HOW CAN YOU GET HOOKWORMS?

- People are infected with this parasite when hookworm larvae (immature worms) in the environment burrow into exposed skin, usually the feet, lower limbs, or buttocks.
- Animal latrines (areas where animals prefer to defecate) may contain hookworm eggs. Once the eggs hatch into larvae, they must mature in the environment for 5-10 days before they can infect a person. Once mature, the larvae can survive for 3-4 weeks in the soil.
- Hunting dogs can also become infected with hookworms and shed eggs in their feces; this is another way people may be infected.
- Hookworms found in wildlife do not cause intestinal infections in people, but there are human hookworms that do. Instead, these animal hookworms migrate through the skin until they die, never reaching adulthoods or laying eggs. This means that people cannot infect other people.

LIFE CYCLE



IMPORTANT POINTS

- Wild canines (and felines) can become infected with hookworms (1) and shed eggs in their feces (2).
- Larvae penetrate the skin of a new host (5). This is how people become infected.
- Larvae burrowing through human skin is what causes CLM.
- Larvae cannot mature into adults in people, so people cannot spread the parasite to other people.

HANDLING AND PREVENTIVE RECOMMENDATIONS

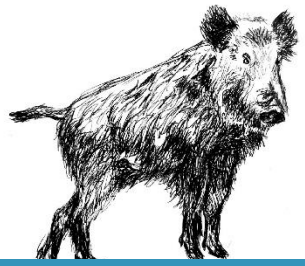
- Wear gloves when handling animal feces or potentially contaminated soil or surfaces
- Wash hands thoroughly after handling animal feces or potentially contaminated soil or surfaces
- Wear appropriate shoes or boots in areas that may be contaminated with hookworm larvae, especially in moist, sandy areas
- Cover exposed skin as much as possible by wearing long pants, socks, or long sleeves (when necessary). This is especially important if you will be sitting, lying, or crawling on the ground.

SPECIES RANGE

- Dog
- Wolves
- Coyotes
- Foxes
- Bobcats
- Cougars

Swine Roundworm

Ascaris suum



WHAT IS ASCARIASIS?

Ascaris suum is a large roundworm found in the small intestines of pigs, including wild swine. This parasite can grow up to a foot in length and can infect people, posing a risk to hunters or wildlife enthusiasts working with swine. Infection with this parasite causes **ascariasis.**

While people may become infected with and harbor these worms for up to 1-2 years, they rarely get sick. If they do, symptoms are usually due infection with a large number of worms and may include:

- Cough
- Abdominal pain or discomfort
- Worms in stool

Rarely, the following problems may occur with heavy infestations:

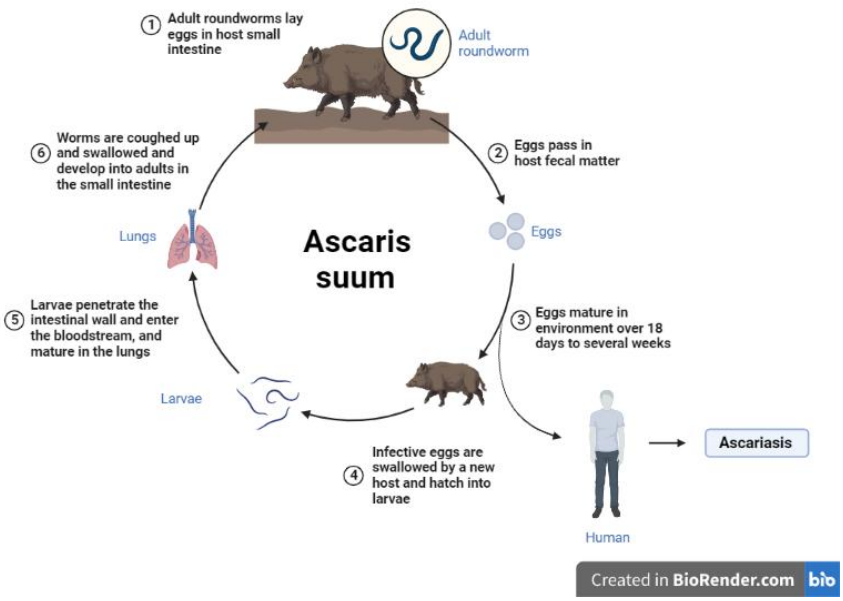
- Intestinal blockage
- Blockage of the bile duct
- Appendicitis
- The adult parasite may come up from the GI tract and emerge through the host's mouth or nostrils

However, these outcomes are rare, and many people may not realize they have a parasitic infection. Regardless, it is important to seek medical care since this parasite may spread to other people and could cause serious sickness.

HOW CAN YOU GET ASCARIASIS?

- Like many other roundworm species, these parasites are transmitted when people handle soil or old swine feces containing *Ascaris* eggs and touch their face or mouth, accidentally swallowing the eggs.
- *Ascaris* eggs must mature in the environment for 18 days to several weeks before they can infect other pigs or people. Once mature, however, they can survive in the environment for up to 10 years, even during times of freezing or extreme heat.
- While meat or viscera from infected animals are not infectious to people, adult ascarids may be seen in the intestines or feces of swine. Migrating larvae may also leave whitish spots ("milk spots") on the liver, likely indicating the pig has a chronic parasitic infection.

LIFE CYCLE



IMPORTANT POINTS

- Humans become infected by swallowing mature eggs (3) from the environment.
- Cough may occur in humans due to larvae (immature parasite) traveling through the lungs (5).
- GI symptoms are due to worms in the small intestine (1).
- Because the parasite matures to adulthood in humans, people may be able to infect other people.

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Wear gloves when handling swine feces or potentially contaminated soil
- Avoid touching your face or mouth when tracking, trapping, or hunting wildlife
- Wash hands thoroughly with soap and water after contact with wildlife or potentially contaminated soil, even if gloves were worn
- Wash and/or cook all wild vegetables and fruits prior to eating (may be contaminated with eggs)
- Dig holes to poop in and then bury feces after. Dig these holes away from streams, rivers, lakes, etc.

SPECIES RANGE

- Wild boar/feral pigs
- Humans

Raccoon Roundworm

Baylisascaris procyonis

WHAT IS BAYLISASCARIASIS?

Baylisascaris procyonis, commonly known as the raccoon roundworm, is a large nematode ('roundworm') found widely distributed among raccoons in the United States. While this parasite does not cause disease in raccoons, humans exposed to eggs shed by raccoons can become infected, resulting in a disease called **baylisascariasis**.

There are different forms of baylisascariasis in humans, depending on where the parasite migrates. The parasite may enter the organs, invade the eyes, or migrate to the central nervous system. Symptoms in people include:

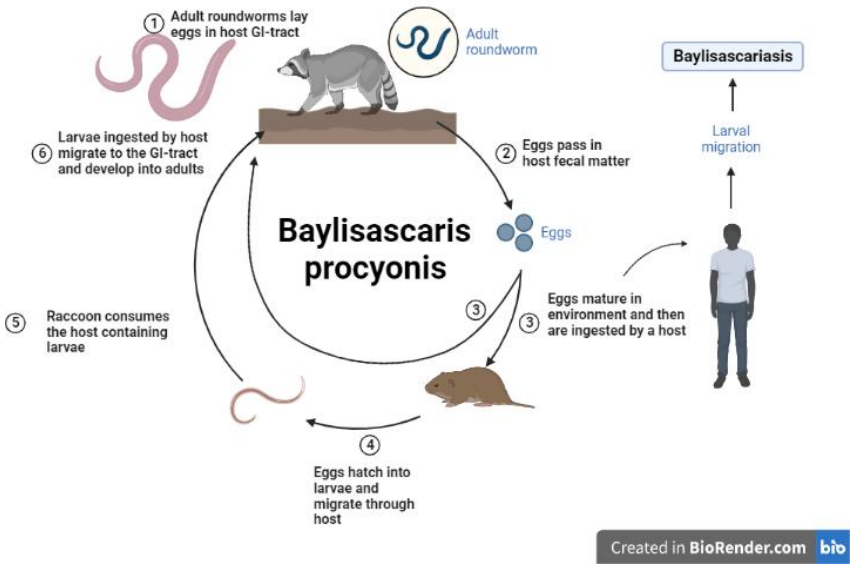
- Nausea, abdominal pain
- Fever, tiredness, weakness
- Inflammation and scarring of the eyes
- Loss of vision
- Irritability, incoordination, loss of balance
- Seizures
- Altered mental status or coma

Each of these conditions has been documented in the United States. Severe neurologic disease can be fatal.

HOW CAN YOU GET *BAYLISASCARIS*?

- People are infected by ingesting *Baylisascaris* eggs shed by raccoons. However, these eggs must mature in the environment for 2-4 weeks before they can infect a new host. Consequently, old raccoon feces, contaminated soil, or tree bark pose the highest risk of transmission. Infection can occur when a person touches one of these sources and then touches their face or mouth, accidentally swallowing microscopic eggs. Eggs can survive in the environment for years, so it is best to exercise caution even in areas that appear free of feces.
- Raccoon latrines are flat areas, usually raised off the ground (e.g., the fork of a tree) where raccoons prefer to defecate. These present a risk to people as they often contain a mixture of old and fresh feces containing *Baylisascaris* eggs.
- Dogs can also become infected with adult *Baylisascaris* roundworms and shed eggs in their feces and thus may serve as another source of infection, especially if they are used to track and hunt raccoons.

LIFE CYCLE



IMPORTANT POINTS

- Raccoons and dogs are the only animals that become infected with adult worms (1) and shed eggs in feces (2). These eggs mature in the environment (3). This is the stage that can infect humans.
- Other animals ingest these eggs and become infected (3), but do not produce eggs, so they cannot infect people.
- Larval migration (4) causes damage, resulting in disease in humans and other animals.

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Avoid directly touching raccoon feces, soil, or potentially contaminated surfaces (e.g., tree bark).
- Wear gloves when handling feces, soil, or potentially contaminated surfaces, especially in and around raccoon latrines.
- Wash hands thoroughly after touching potentially contaminated surfaces, even if gloves were worn.
- Deworm hunting dogs regularly (as advised by a veterinarian).

SPECIES RANGE

Harbor adult parasites & shed eggs:

- Dogs
- Raccoons

Clinical disease reported in:

- Humans
- Dogs
- Birds
- Most warm-blooded animals

Capillaria

Capillaria hepatica

WHAT IS CAPILLARIASIS?

Hepatic capillariasis is a disease caused by *Capillaria hepatica,* a small, delicate nematode (roundworm) that is roughly the size of a paperclip. This parasite prefers rodents but has been documented in a wide array of wildlife, including foxes, swine, and rabbits.

Capillaria hepatica invades the liver, causing some of the following problems in people:

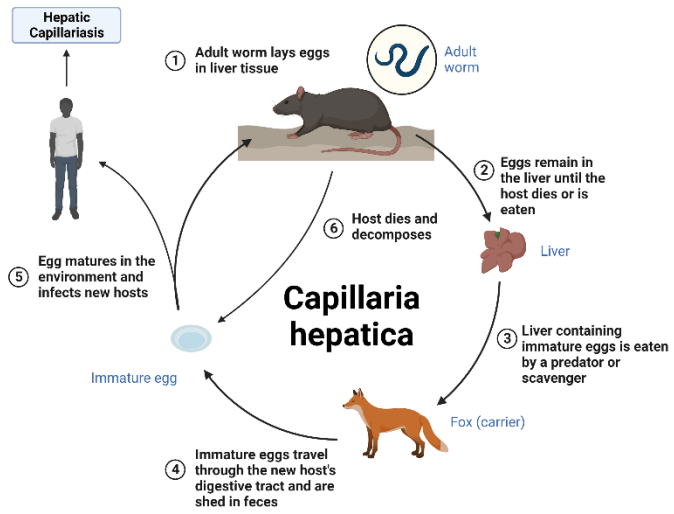
- Inflammation and enlargement of the liver
- Persistent fever
- Liver dysfunction or failure (serious cases)
- Death

The symptoms caused by this parasite are generally liver-related but vague, making it difficult to diagnose. This disease is rare, but *Capillaria hepatica* is found in wildlife worldwide and human cases of capillariasis have been documented in the United States. This disease is likely more common than documented since it is difficult to diagnose. Severe cases may be fatal.

HOW CAN YOU GET CAPILLARIA HEPATICA?

- The most common way people become infected with capillariasis is by swallowing *Capillaria* eggs from dirt contaminated with the feces of wildlife.
- *Capillaria* eggs must mature in the environment over the course of at least 6 weeks (up to 5 months) in damp soil before they can infect people. Because of this, fresh feces do not pose a risk for this specific parasite, but latrines (areas where animals prefer to defecate) may contain mature eggs from old feces.
- Human-to-human transmission technically occurs when a person is “spuriously infected” after eating raw/undercooked liver, meaning that they swallow immature eggs and pass the eggs (still immature) in their feces without getting sick. Once these eggs mature in the environment, they can cause true infection if ingested by another person.

LIFE CYCLE



IMPORTANT POINTS

- *Capillaria* lays eggs in the rodent's liver (1) and are released when the host either dies and decomposes or is eaten (2).
- *Capillaria* eggs take time to mature, so if eaten immediately (3) they will not infect the host, instead passing through their digestive tract without causing sickness (4).
- People become infected by swallowing mature eggs (5)

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Wear gloves when handling feces, soil, or potentially contaminated surfaces, especially in and around animal latrines
- Wear gloves when handling dead carcasses (especially the liver)
- Wash hands thoroughly after touching potentially contaminated soil or surfaces, even if gloves were worn
- Wash or cook wild fruits and vegetables
- Cook or freeze (for at least one week) liver from wild game to kill parasite eggs
- Dig a hole away from water sources (rivers, ponds, etc.) to poop in. Cover with soil afterward.

SPECIES RANGE

- Rodents (i.e., rats)
- Rabbits
- Foxes
- Swine

Echinococcus

Echinococcus multilocularis, E. granulosus

WHAT IS ECHINOCOCCOSIS?

Echinococcosis is a disease caused by the larval (immature) stage of tiny tapeworms that form cysts on the organs of people and animals. There are two forms of Echinococcosis found in U.S. wildlife, depending on the *Echinococcus* species. The causative agent of **alveolar echinococcosis** is ***Echinococcus multilocularis***, whereas **cystic echinococcosis** is caused by ***Echinococcus granulosus***. Both forms of disease are a result of larvae forming cysts (termed "hydatid" cysts) on organs. Symptoms of each depend on where the cysts form.

ALVEOLAR ECHINOCOCCOSIS

The adult tapeworm is found in wild canines, usually foxes and coyotes, but the immature (larval) stage can infect humans and other animals. Cysts generally grow on the liver.

Clinical signs of alveolar echinococcosis may include:

- Abdominal pain or discomfort
- Weakness and weight loss
- Blockage of the bile duct
- Liver failure

Rarely, these cysts may spread to the lungs, spleen, or brain. While cysts may take years to cause symptoms in the host, the prognosis is poor and results in the death of more than 80% of infected people.

CYSTIC ECHINOCOCCOSIS

Similar to *E. multilocularis*, the adult tapeworm is found in wild canines, but many other species, including humans, can be infected by the immature (larval) stage. Cysts most commonly develop on the liver and lungs but may invade other organs. Clinical signs of cystic echinococcosis may include:

- Inflammation of the liver and lungs
- Breathing problems
- Liver failure

If the cysts rupture, the following clinical signs may occur:

- Fever
- Anaphylactic shock (allergic reaction)
- Itchy rash
- Cysts may spread to other organs

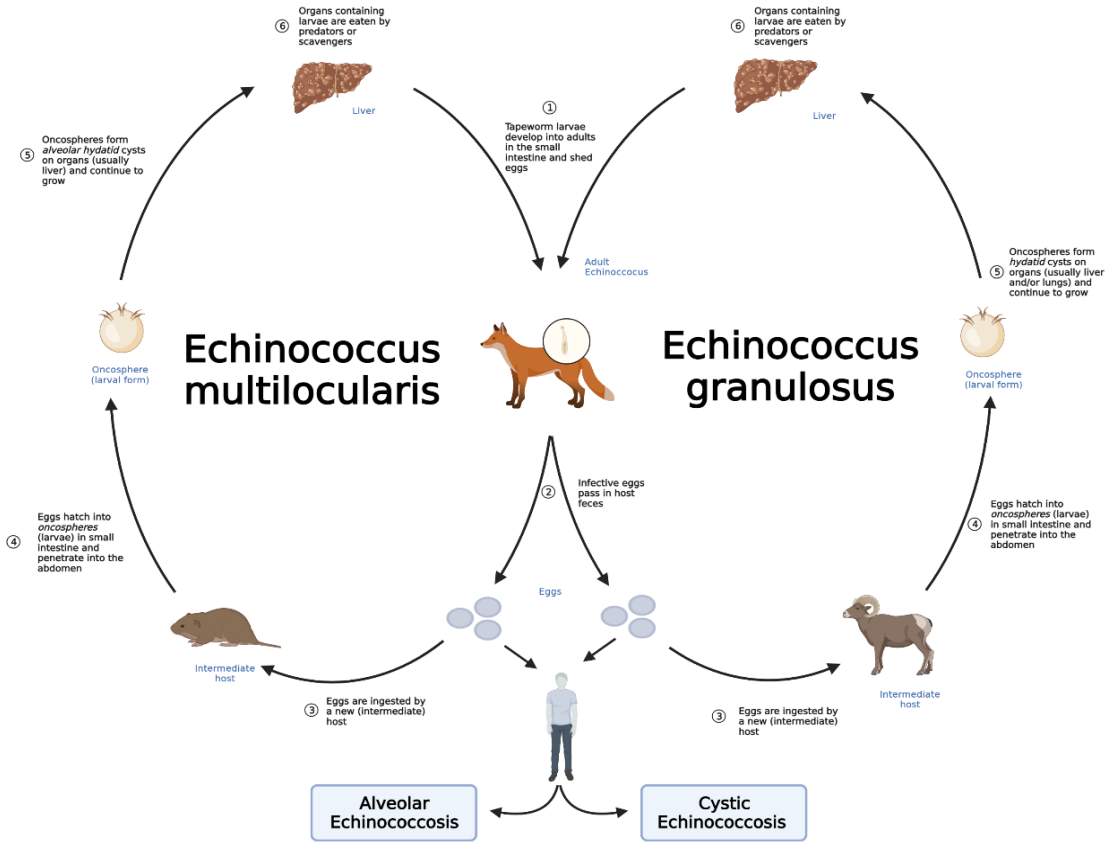
HOW CAN YOU GET ECHINOCOCCUS?

- Human infection occurs when *Echinococcus* eggs are swallowed. This can happen in a few different ways, including consumption of food or water contaminated with the feces of foxes or coyotes, directly handling the feces of these animals, handling contaminated soil, or improper handling of the carcass.

- Unlike many parasite eggs, *Echinococcus* eggs shed in feces are already mature and capable of infecting new hosts. Thus, handling fresh or old feces can result in infection. Animal latrines or areas where wild canines mark their territory with scat pose a risk to people. Animals infected with adult *Echinococcus* do not appear ill.

- You may observe cysts in the organs of other wild game, including moose, deer, and elk, but the larvae (called 'oncospheres') in these cysts are not infective to humans. However, you should still exercise caution when handling these carcasses to prevent transfer of other unknown diseases.

LIFE CYCLE



IMPORTANT POINTS

- Humans are infected by swallowing eggs shed by canine species (3), including foxes, coyotes, or wolves.
- Humans and other animals can be infected with the cysts containing immature parasites (5) of either species but cannot produce eggs.
- Cyst stage is usually seen in either rodents (*E. multilocularis*) or ungulates such as sheep, moose, or deer, etc. (*E. granulosus*). Even if eaten, the cyst stage is not infectious to people.
- Cysts caused by *E. multilocularis* generally occur on the liver, whereas cysts formed by *E. granulosus* prefer either the liver or lungs. However, cysts may form on other organs (5).
- There is no human-to-human transmission.

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Avoid directly touching animal feces and potentially contaminated soil.
- Wear gloves when handling and harvesting wildlife, especially foxes and coyotes
- Wash hands thoroughly after handling wildlife or soil, even if gloves were worn
- Wash or cook wild fruits and vegetables before consuming
- Do not drink from unclean water sources. Boil water prior to drinking.

SPECIES RANGE

- Foxes
- Coyotes
- Wolves
- Bobcats (rarely)
- Many other species can be infected with cyst stage (non-infective to humans)

Giardia

Giardia duodenalis

WHAT IS GIARDIASIS?

Giardia duodenalis is a microscopic parasite that causes diarrheic disease called **giardiasis** in animals and humans. This parasite is found in many different species of animals. While certain types of *Giardia duodenalis* (referred to as "assemblages") only infect certain species and do not infect humans, some types found in wildlife are capable of infecting people as well. These types may be found in species such as beavers, opossums, and some birds.

Some people may become infected but never become physically sick (show symptoms), while others may experience the following:

- Stomach cramps, nausea
- Gas
- Vomiting
- Greasy, stinky diarrhea that tends to float
- Dehydration and fatigue

Most people recover after 2-6 weeks, but in some cases they may experience long-term symptoms, including:

- Arthritis (inflammation of the joints)
- Irritable bowel syndrome
- Diarrhea persisting for years

Eventually, *Giardia* can cause weight loss and prevent the body from absorbing important vitamins and nutrients. In some instances, people may appear to recover for a few weeks but then experience symptoms again later.

HOW CAN YOU GET GIARDIA?

- Animals infected with *Giardia* shed cysts (the "egg" stage) in their feces. Unlike some other parasites discussed in this manual, *Giardia* cysts can immediately infect people or animals. People get this parasite by accidentally swallowing these microscopic cysts.

- Giardia cysts prefer cool, moist environments, including cool bodies of water or streams. Humans can become infected with *Giardia* by drinking contaminated water. They can also get it by handling contaminated soil and then touching their face or mouth.

- Infection may also occur when a person handles contaminated animal feces (fresh or old), carcasses, or furs and then touches their face or mouth.

LIFE CYCLE

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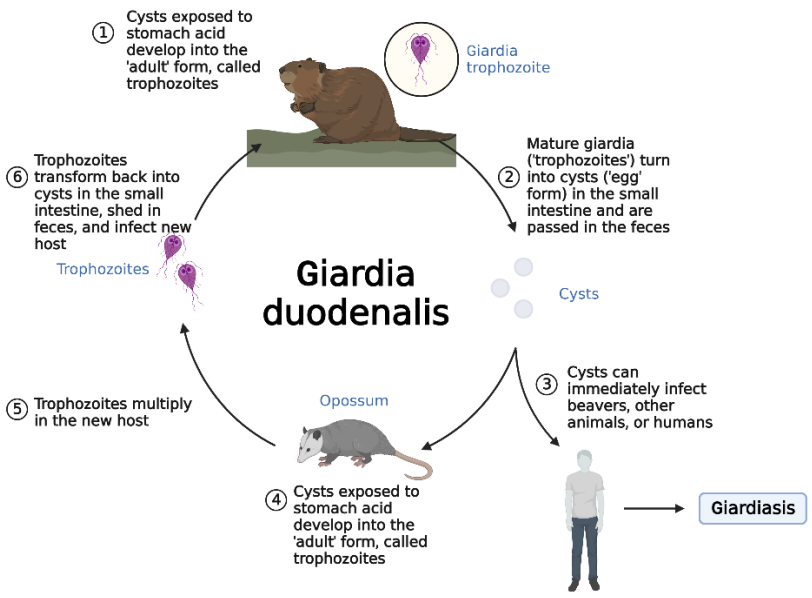


IMPORTANT POINTS

- Some animals (e.g., beavers) shed *Giardia* cysts ("egg" stage) in their feces (3). This is the stage that can infect people.
- Cysts mature into the adult stage – called "trophozoites" – in the small intestine (4 and 5). This is the stage that causes diarrhea and vomiting in people.
- People can shed *Giardia* cysts and may in turn infect other people.

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Boil water prior to drinking. Maintaining a rolling boil for at least 1 minute kills Giardia cysts.
- Filter water prior to drinking.
- Wear gloves when handling wildlife or wildlife carcasses, including furs, since cysts are immediately infectious.
- Wash hands after handling soil or after contact with potentially contaminated animals, furs, carcasses, or water sources, even if gloves were worn.
- Wash or cook wild fruits and vegetables prior to eating.

SPECIES RANGE

- Beavers
- Opossums
- Birds

Taenia Tapeworms

Taenia multiceps, Taenia serialis

WHAT IS COENUROSIS?

Coenurosis is a disease caused by a few different tapeworms, but in the United States ***Taenia multiceps*** and ***Taenia serialis*** are the significant species found in wildlife. The adult tapeworms can reach lengths longer than a person is tall and are found in the intestines of wild canines.

Symptoms of coenurosis are due to coenuri (lumps containing the immature parasite) forming in the body.

TAENIA MULTICEPS

Taenia multiceps is the most common cause of coenurosis in the United States. This parasite tends to form coenuri in the brain or spinal cord, resulting in neurologic symptoms:

- Loss of balance/coordination
- Changes in behavior
- Loss of consciousness ("passing out")
- Seizures
- Death

This illness closely resembles cysticercosis, which is caused by *Taenia solium*.

TAENIA SERIALIS

Taenia serialis is less common and generally less severe. This parasite prefers to form coenuri under the skin, resulting in:

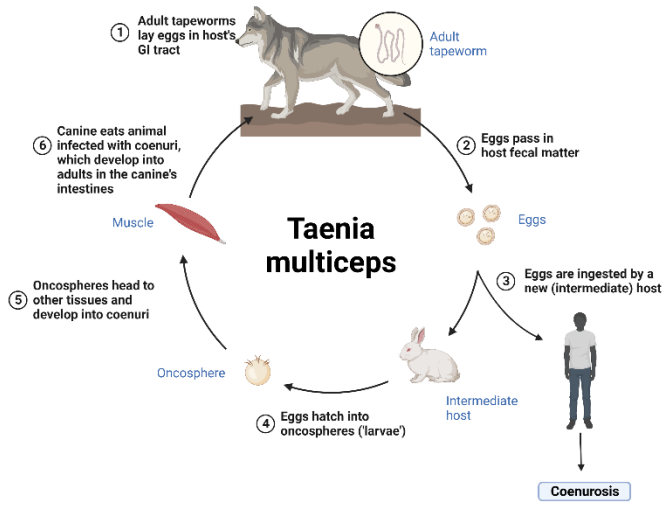
- Lumps under the skin; generally painless, but may be tender
- Loss of movement or function due to placement of lumps (e.g., a lump in the neck may cause difficulty swallowing)
- Vision loss or eye pain due to lumps forming in the eyeball or eyelid

These lumps (coenuri) may increase or decrease in size over time.

HOW CAN YOU GET COENUROSIS?

- People become infected with coenurosis when they accidentally ingest *Taenia multiceps* eggs shed in the feces of wild canines, or *Taenia serialis* eggs from fox feces. *Taenia* eggs are immediately infectious, so infection occurs when people touch contaminated feces or soil and then touch their face or mouth.
- Like *Taenia solium*, these parasites require two different hosts. In one host, they hatch from eggs and live as larvae in coenuri until eaten by another host. In this second host, they grow from the larval stage to adults and shed eggs. Humans only become infected with the larval stage.
- Since humans cannot support the adult stage of *Taenia multiceps/serialis*, coenuri (containing the immature parasite) found in wildlife are not infective.

LIFE CYCLE



IMPORTANT POINTS

- *Taenia multiceps* adults shed eggs in the feces of wild canines (2). This is how people become infected.
- The immature tapeworm forms coenuri in the body (5). This is what causes Coenurosis in people.
- The adult stage of *Taenia multiceps* does not occur in people. Thus, they cannot get this tapeworm from eating infected meat (unlike *Taenia solium)*
- There is no human-to-human transmission.

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Wear gloves when handling animal feces or potentially contaminated soil
- Since these eggs are immediately infectious, wear gloves when handling animal carcasses or furs of foxes and other wild canines
- Wash hands after handling, regardless of whether gloves were worn
- Do not touch your face or mouth after handling wildlife or soil
- Wash or cook wild fruits and vegetables prior to eating

SPECIES RANGE

Taenia multiceps

- Foxes
- Wolves
- Coyotes

Taenia serialis

- Foxes

Coenuri (not infectious to people) seen in:

- Sheep and goats (*T. multiceps*)
- Rabbits (*T. serialis*)
- Other herbivorous (plant-eating) species

Pork Tapeworm

Taenia solium

WHAT ARE TAPEWORMS?

There are several *Taenia* tapeworms of human significance found in wildlife. *Taenia solium* is a tapeworm found in wild swine. The adult tapeworm can grow to lengths measuring 3-4x the height of the average person; they are composed of short, repeating, rice-like segments ("proglottids") that detach and may be seen in feces. Tapeworms require different hosts for different stages of growth and cause different diseases depending on which stage is infecting the person. *Taenia solium* causes both taeniasis (infection with the adult tapeworm) and cysticercosis (infection with the immature tapeworm) in people.

TAENIASIS

Taeniasis occurs when adult tapeworms infect human intestines. While there are many species of tapeworms that can cause this disease, ***Taenia solium*** is found in wild swine and is capable of infecting people.

Symptoms may include:

- Abdominal pain
- Loss of appetite, weight loss
- Nausea
- Proglottids in feces

Adult *Taenia* tapeworms do not usually cause further issues, but complications may arise if the parasite becomes lodged in the appendix or in the bile and pancreatic ducts. Adult tapeworms can survive for years in the human body.

CYSTICERCOSIS

Cysticercosis is also caused by *Taenia solium.* This disease occurs when the immature stage of the parasite forms cysts (called "cysticerci") in their host. This condition most commonly occurs in pigs, but under the right circumstances it can occur in people.

If these cysts form in muscle, they result in:

- Lumps under skin
- Usually do not cause illness

However, if these cysts form in the brain, spinal cord or eye, they can cause more serious problems:

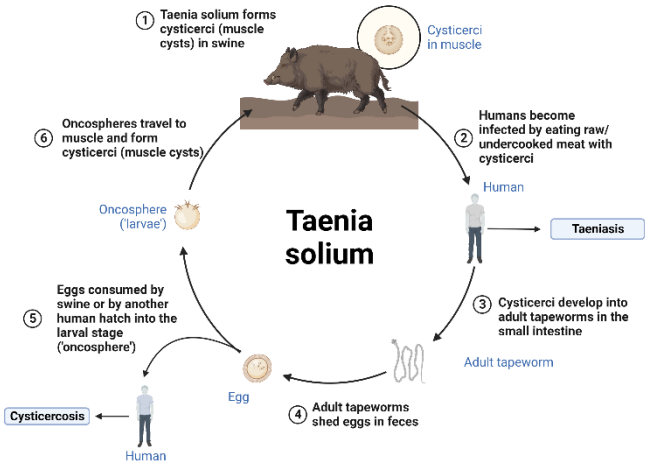
- Seizures, headaches
- Confusion, problems with balance
- Swelling of the brain and increase in fluids around the brain
- Damaged vision
- Stroke
- Death

Cysticercosis is a rare disease, but it has serious consequences, so it is best to take precautions.

HOW CAN YOU GET TAENIASIS?

- The most common way that people get **taeniasis** is by eating raw or undercooked pork infected with *Taenia solium* "cysticerci". Cysticerci are immature tapeworms that have formed cysts in the infected pig's tissues.
- Taeniasis is the condition generally seen in people since the parasite can mature to adulthood in their intestines, but under the right circumstances individuals may become infected with immature tapeworms instead, suffering from **cysticercosis**.
- People do *not* get cysticercosis from wild swine. People get cysticercosis from people infected with Taeniasis—these people shed *Taenia* eggs in their feces. Poor hygiene among people may result in accidental ingestion of these eggs.
- To summarize, people can get taeniasis from eating uncooked pork. When they shed eggs in their feces, they may infect either pigs or other people with cysticercosis. These infected animals could then infect people who consume their meat. Refer to the life cycle for more information.

LIFE CYCLE



- *Taenia* requires two hosts to complete its life cycle. The tapeworm matures from the egg stage to the larval stage (cysticerci) in one host (5-6). In a new host, the larvae develop into adults and shed eggs (2-4), restarting the cycle.

IMPORTANT POINTS

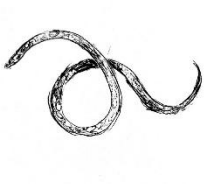
- The larvae (immature parasite) form cysts in swine muscle (1). If this muscle is eaten by a human (2), they get taeniasis.
- People with Taeniasis shed tapeworm eggs in their feces. If these eggs are swallowed by another person, they grow into larvae and form cysts in the person's muscles. This is called cysticercosis

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Cook pork to a minimum internal temperature of 165 degrees Fahrenheit to kill cysticerci
- Wear gloves when handling swine carcasses
- Wash hands after contact with potentially contaminated carcasses, dirt, or surfaces, regardless if gloves were worn
- Wash or cook wild fruits and vegetables prior to eating
- Dig holes to poop in and then bury feces after. Dig these holes away from streams, rivers, lakes, etc.
- If you suspect you have taeniasis, exercise proper hygiene to prevent infecting yourself or someone else with cysticercosis and contact your doctor.

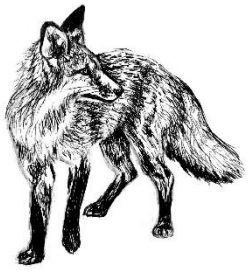
SPECIES RANGE

- Humans
- Swine



Ascarid Roundworms

Toxocara canis, T. cati



WHAT IS TOXOCARIASIS?

Toxocara species are large ascarid roundworms capable of infecting people. *Toxocara canis* and *Toxocara cati* are commonly associated with domestic dogs and cats (respectively) but are also carried by wild canines and felines. These parasites shed eggs in their animal host's feces. Occasionally, people can become infected, resulting in a disease called **toxocariasis.**

While individuals infected with toxocariasis are usually asymptomatic, they may experience different conditions depending on where the larvae migrate. When the larvae migrate through internal organs (referred to as visceral larva migrans, or VLM), symptoms may include:

- Fever and fatigue
- Coughing
- Abdominal pain
- Enlarged liver
- Pneumonia

If the larvae travel to the eyes, then they can cause:

- Inflammation of the eye
- Vision loss

This is referred to as ocular larva migrans (OLM).

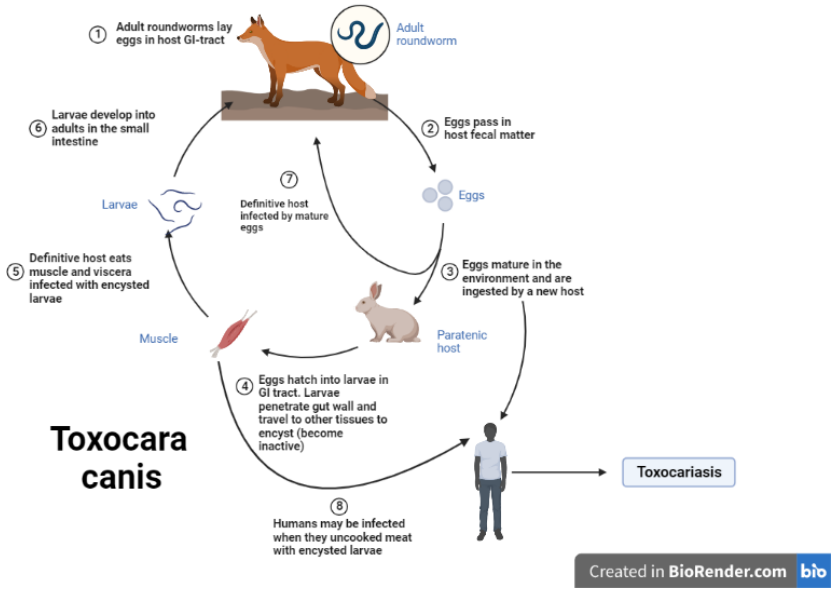
Very rarely, the larvae invade the nervous system, resulting in neural larva migrans (NLM). Refer to the section *on Baylisascaris procyonis* for more information on NLM.

Toxocariasis is not usually fatal, but can result in death if the heart, lungs, or nervous system are strongly afflicted.

HOW CAN YOU GET TOXOCARIASIS?

- People can become infected by inadvertently swallowing microscopic eggs shed by wild canines and felines. These eggs must mature in the environment for 2-4 weeks before they can infect the next host, but once mature they can survive in soil for years. Due to the prevalence of these parasites in not only wild animals but also domestic pets, it is best to exercise caution when handling soil in any area. People can become infected if they touch soil, feces, or other surfaces contaminated with eggs and then touch their face or mouth.
- Many egg-shedding animals, such as coyotes or foxes, utilize scat to mark their territories and communicate with other animals. These areas likely have a higher number of eggs present in the soil and pose a greater risk upon contact.
- Another less common method of human infection is through the consumption of raw or undercooked meat containing inactive larvae. This meat could be from a variety of wildlife species, including small mammals such as rabbits.

LIFE CYCLE



IMPORTANT POINTS

- Wild canines/felines shed eggs in feces (2). Once these eggs mature (3), they can infect humans
- Non-canine/feline animals can ingest eggs and become infected (3), but do not produce eggs. The larvae encyst in tissues and raw or undercooked meat from these animals can infect humans if consumed (8)
- When humans become infected (3 and 8), clinical signs occur due to larval migration through organs and tissues (4)

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Avoid directly touching animal feces, soil, or potentially contaminated surfaces
- Wear gloves when handling feces, soil, or potentially contaminated surfaces
- Wash hands thoroughly after touching potentially contaminated surfaces, even if gloves were worn
- Do not consume raw or undercooked meat or viscera. When cooking, follow temperature guidelines for each type of game meat to kill encysted larvae.
- Wash or cook wild fruits and vegetables prior to eating
- Deworm hunting dogs regularly (as advised by a veterinarian)

SPECIES RANGE

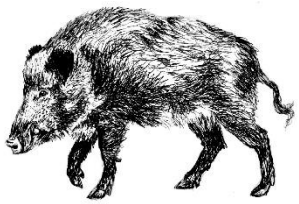
Harbor adult parasites & shed eggs:

- Wild and domestic canines such as foxes, coyotes, or wolves
- Wild and domestic felines such as bobcats or cougars

Clinical disease reported in:

- Wild and domestic canines and felines
- Humans
- Small mammals such as rabbits

Trichinella



WHAT IS TRICHINOSIS?

***Trichinella* species** are tiny, hair-like parasites that cause disease in a variety of mammals, including humans. *Trichinella* is found among carnivorous (meat-eating) and omnivorous (meat- and plant-eating) animals, especially wild boar and bears. Infection with this parasite results in **trichinosis.**

People with trichinosis initially experience GI signs, including:

- Nausea, vomiting
- Diarrhea and abdominal pain

Over time, these symptoms can progress to:

- Headache
- Fever, chills, and cough
- Muscle and joint pain
- Swollen eyes
- Skin rash

-

Trichinosis can range from mild disease that resolves within a few months to one characterized by potentially fatal heart and breathing problems. Symptoms may persist for months.

Placeholder

HOW CAN YOU GET TRICHINELLA?

- People become infected with *Trichinella* when they consume raw or undercooked meat containing the larvae. Infection is most often associated with consumption of pork or bear meat, but many other animals can carry this parasite, such as predators or scavengers.
- Infection may also occur through cross-contamination. This can happen if you do not appropriately wash your hands, countertops, or other surfaces after handling raw meat. Using infected surfaces and then touching your face or mouth may lead to accidental ingestion of *Trichinella* larvae.

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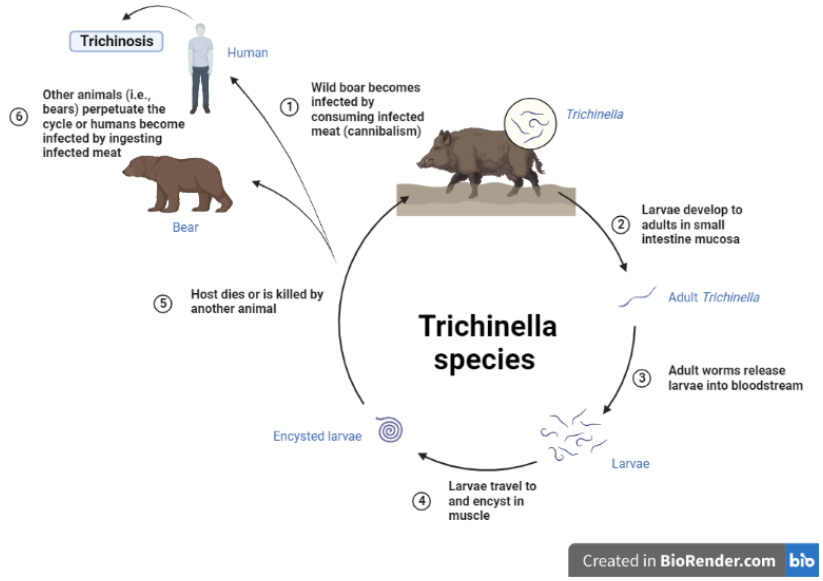
LIFE CYCLE



IMPORTANT POINTS

- Larvae form cysts in the host's muscles (4) and if consumed infect the next host (6). This is how humans become infected.
- Once infected, humans experience GI signs due to *Trichinella* maturing in the small intestine (2).
- The larvae migrate to the individual's muscles, forming cysts (4) and causing more severe symptoms.
- Many different animals can become infected and harbor *Trichinella* in their muscles

HANDLING AND PREVENTIVE RECOMMENDATIONS

- Heat is the best way to kill *Trichinella*. Cook pork and other wild game to 137° F (77° C). Do not use a microwave to cook game meat, as the inconsistent heating may not effectively kill *Trichinella*.
- Freezing meat at 5° F (-15° C) for 20 days may kill some *Trichinella*, but some species in wild game are more resilient, surviving -4° F (-20° C) for 6 months.
- Do not rely on curing (salting), smoking, or drying meat to kill *Trichinella*. Homemade jerky and sausages have been the source of Trichinosis outbreaks.
- When cutting or preparing meat for cooking, use a cutting board. Afterward, wash the cutting board with soap and hot water or run it through the dishwasher to kill the parasite.

SPECIES RANGE

- Wild boar
- Bears
- Foxes
- Wolves
- Bobcats
- Cougars