

# ***Construction of a Veterinary Prevention and Control Strategy System for Feline-Derived Toxoplasmosis Based on the One Health Perspective***

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**Abstract.** Toxoplasmosis is a significant global zoonotic parasitic disease, and cats, as the sole definitive hosts, play a central role in its transmission chain. With the surging number of companion cats, close contact between humans and pets has introduced new public health risks; however, current prevention and control strategies rely largely on passive education from human healthcare providers, while the proactive and leading role of veterinarians is conspicuously absent. This study employs a literature review approach to analyze three key issues: the critical risk points in the transmission of feline-derived *Toxoplasma gondii* to humans; the rationale for positioning veterinarians as core implementers; and the development of veterinarian-led, integrated community prevention and control strategies. Using the One Health framework, this article systematically analyzes the key risk nodes in the "cat-environment-human" transmission chain of *Toxoplasma gondii*. It then demonstrates the irreplaceable role of veterinarians in diagnosis, surveillance, infection source management, and prevention education. Finally, it constructs a veterinarian-led closed-loop prevention and control strategy system that covers four major modules: diagnosis and surveillance, treatment and management, prevention systems, and cross-departmental collaboration. The strategy outlined in this article positions veterinarians as initiators and information hubs for community-based *Toxoplasma* prevention and control, offering a direct reference for veterinary clinics to provide public health services.

**Keywords:** *Toxoplasma gondii*, cats, veterinary public health, prevention and control strategies, One Health, zoonoses

## **1. Introduction**

Toxoplasmosis is a global zoonotic parasitic disease caused by *Toxoplasma Gondii* ; approximately one-third of the global population are seropositive [1], and the disease imposes a heavy burden on immunocompromised individuals and fetuses of pregnant women. Felids are the sole definitive hosts; the oocysts shed in their feces can survive for extended periods in the environment and widely contaminate soil and water sources, subsequently infecting intermediate hosts such as humans and livestock, thereby establishing the cat as the central hub in the transmission chain [2]. In recent years, the number of pet cats has surged, leading to increased shared living spaces and close contact

between humans and cats; this has created favorable conditions for transmission within the "cat-environment-human" chain [3]. For instance, a survey in Shanghai's Minhang District revealed a certain prevalence of infection among the cat population, posing a persistent risk of exposure to cat-owning households [4]. Traditional prevention and control measures often focus on awareness campaigns targeting humans and healthcare providers, but these are passive and do not proactively address the infection source in cats. Therefore, it is imperative to leverage veterinary expertise to manage definitive hosts, cut off sources of transmission, and establish a proactive, forward-looking prevention and control system to address this major public health challenge.

This study examines the necessity and feasibility of a veterinarian-led, systematic approach to controlling *Toxoplasma* transmission at the community and household levels. Focusing on the "cat-veterinarian-human" pathway, it proposes integrating fragmented, reactive measures into a cohesive prevention and control system. By analyzing the transmission and interaction mechanisms among cats, humans, and the environment, and by positioning veterinarians as lead initiators and information hubs, this study deepens the "One Health" framework and offers a concrete paradigm for its implementation. In practical terms, this research addresses the gap regarding the role of veterinarians in community-based disease control and prevention. By integrating the latest evidence on diagnosis, treatment, prevention, and health education to establish standardized protocols, the study aims to reduce feline infection rates and environmental contamination. This directly protects high-risk groups—such as pregnant women and immunocompromised individuals—while also promoting community health.

This study addresses three interrelated research questions: first, what are the key risk points for the transmission of cat-derived *Toxoplasma gondii* to humans; second, what essential roles veterinarians play in interrupting the transmission of *Toxoplasma gondii*; and third, the core question of what approaches can be adopted to develop an integrated community prevention and control strategy for toxoplasmosis under veterinary leadership.

## **2. Analysis of transmission mechanisms and risk factors for toxoplasmosis**

### **2.1. Biological characteristics and transmission chain of *Toxoplasma gondii***

*Toxoplasma gondii*, an obligate intracellular apicomplexan parasite, has a life cycle where felids are the sole definitive hosts. After cats ingest tissues from intermediate hosts (such as rodents or birds) containing *Toxoplasma* oocysts, the parasite undergoes sexual reproduction within the epithelial cells of the cat's small intestine, ultimately forming oocysts that are shed in the feces [1]. Oocysts shed into the external environment become infective after sporulating over a period of 1 to 5 days; due to the high resistance of the oocyst wall to physicochemical factors, they can survive in soil and water for months or even years, constituting a persistent environmental reservoir of infection [5].

There are three main routes of *Toxoplasma* transmission: oral ingestion, vertical transmission, and iatrogenic transmission (such as through organ transplantation or blood transfusion). Among them, "oral ingestion" is recognized as the absolutely dominant route of infection. Specifically, this route can be further subdivided into two main pathways: first, the ingestion of food or water contaminated with sporulated oocysts, or the ingestion of oocysts from soil via hand-to-mouth contact—a pathway directly linked to environmental contamination by the definitive host (cats); and second, the consumption of undercooked meat (such as pork, mutton, or poultry) containing tissue cysts, which reflects horizontal transmission among intermediate hosts [3]. This study focuses on the first pathway—namely, the core transmission chain of "cat → environment → human/animal." The oocysts shed by cats are the initiating factor for *Toxoplasma* contamination of the external

environment; this biological fact dictates the critical importance and logical necessity of implementing prevention and control interventions targeting cats.

## 2.2. Explanation of risk mechanisms based on the one health framework

Applying the One Health framework to examine *Toxoplasma* transmission clearly reveals the deep interconnectedness and mechanisms of mutually reinforcing interaction among animal, human, and environmental health.

Regarding animal health, *Toxoplasma gondii* infections in cats are predominantly subclinical or inapparent. Outwardly, healthy cats can shed millions of oocysts during initial infection, acting as asymptomatic "mobile sources of infection." Data from seroprevalence surveys in certain regions of China indicate that *T. gondii* infection rates among cat populations remain at a significant level [4, 6].

Regarding human health, the risks posed by *Toxoplasma gondii* vary considerably across populations. While immunocompetent individuals typically remain asymptomatic or present only with self-limiting lymphadenopathy following infection, primary infection in pregnant women can lead to severe consequences, including miscarriage, stillbirth, or congenital toxoplasmosis in the newborn (manifesting as hydrocephalus, chorioretinitis, etc.). By contrast, immunocompromised individuals (such as AIDS patients and organ transplant recipients) are at risk of disseminated toxoplasmosis, which can be life-threatening [3].

Regarding environmental health, the extreme environmental resilience of *Toxoplasma* oocysts renders them difficult-to-eliminate contaminants. Conventional disinfectants have limited efficacy against sporulated oocysts; only physical methods—such as exposure to high temperatures ( $>60^{\circ}\text{C}$ ) or prolonged desiccation—can effectively inactivate them.

The interactions among these three dimensions create a vicious cycle: the high prevalence of infection and the nature of asymptomatic infection in cats (animal dimension) lead to continuous environmental contamination with oocysts (environmental dimension); humans ingest these oocysts through daily activities involving contact with contaminated soil, cat litter, or water sources (human dimension); and the generally low level of public awareness regarding prevention and control exacerbates the lack of management for cats—particularly strays—thereby further worsening environmental contamination. To break this cycle, an actor is needed to intervene at a critical transmission node. Veterinarians—by virtue of their professional expertise and the nature of their practice, which brings them into direct contact with the definitive host (cats)—are the natural and uniquely best-suited candidates to fulfill this role.

## 3. Construction of a veterinarian-led prevention and control strategy system for toxoplasmosis

### 3.1. The pivotal role of veterinarians in the prevention and control of *Toxoplasma gondii* in cats

In preventing and controlling feline toxoplasmosis, the veterinarian's role covers diagnosis, monitoring, treatment, and management; their value extends beyond the care of individual patients to controlling public health risks within the community.

In diagnosis and monitoring, veterinarians play a pivotal role in initiating risk identification and early warning. For cats newly introduced into a household, those in homes planning a pregnancy, or those in households with immunocompromised members, systematic serological screening should be implemented; the combined interpretation of *Toxoplasma* -specific IgM and IgG antibodies

allows for the assessment of the infection stage and the risk of oocyst shedding, with PCR testing utilized to provide etiological evidence when necessary. The application of a novel recombinant antigen ELISA has further improved detection accuracy [7]. More importantly, community veterinary clinics can serve as "sentinel sites" for *Toxoplasma* surveillance: by aggregating clinical data to establish baseline infection rates among local cat populations—and integrating ongoing analyses from initiatives such as stray cat management and TNR programs [8]—these clinics can identify infection hotspots and epidemiological trends. This transforms veterinarians from passive providers into information hubs that issue proactive public health alerts.

In terms of treatment management, the veterinarian's primary task is controlling sources of infection. For cats diagnosed with toxoplasmosis, clindamycin is the drug of choice; the treatment course lasts 2 to 4 weeks and requires individualized adjustment. For infected cats that are asymptomatic but in the oocyst-shedding stage [9], a joint decision must be made with the owner after weighing the benefits of treatment: high-risk families tend to initiate treatment to shorten the oocyst-shedding stage and strictly isolate the cats, while ordinary families adopt strict indoor isolation and close observation. Whatever approach is chosen, veterinarians must strictly enforce infection management: keep infected cats strictly indoors; clean litter boxes daily with gloves, double-bag waste for disposal; and disinfect regularly with boiling water or steam to prevent transmission via oocyst sporulation [10]. Throughout this process, the veterinarian acts not only as the architect of treatment plans but also as an educator, supervisor, and evaluator regarding management measures.

In this way, veterinary practice integrates individual diagnosis and treatment with herd monitoring, and clinical therapy with the control of infectious sources, thereby fulfilling the multifaceted functions of veterinary public health.

### 3.2. A veterinarian-led preventive system: from pets to the community

Prevention is the most cost-effective aspect of *Toxoplasma* control and management, and the area where veterinary practice can exert the most enduring influence. This study proposes a "four-in-one" prevention model based in community veterinary clinics, which integrates fragmented preventive advice into a systematic and actionable service workflow.

First, establish health records and conduct regular screening. Veterinary clinics should create a *Toxoplasma* health record for every registered cat, documenting key information such as lifestyle (indoor vs. outdoor), diet, and past test results. It is recommended to perform serological screening at least once a year for high-risk individuals—such as cats that roam outdoors or are fed raw meat, to conduct baseline testing for newly adopted cats, and to offer targeted screening services for cats in households planning a pregnancy. Keeping these records updated allows veterinarians to track changes in each cat's risk status and provide personalized preventive advice.

Secondly, regarding deworming and health management—clarifying key preventive practices. Veterinarians must correct a widespread misconception among cat owners: that routine broad-spectrum dewormers are ineffective against *Toxoplasma gondii* [11]. Standard feline dewormers typically target nematodes and cestodes but do not kill *Toxoplasma gondii*, an organism belonging to the phylum Apicomplexa. Effective prevention of *Toxoplasma* infection relies primarily on behavioral management; veterinarians should clearly communicate three core measures: ① prohibit the feeding of raw or insufficiently cooked meat; ② prevent cats from hunting outdoors; and ③ clean the litter box daily (ensuring removal before oocysts become infectious) [9]. These three simple and cost-free behavioral measures are the most effective means of preventing feline infection and the subsequent shedding of oocysts into the environment.

Third, health education for cat owners should be precise and targeted. Veterinarians serve as the most authoritative source of information on *Toxoplasma* prevention and control for cat-owning households. Health education should not be generic but rather precisely tailored to specific needs. For pregnant women and households planning a pregnancy, veterinarians should provide exceptionally clear guidance: there is no need to abandon the cat during pregnancy, provided the principle of "having someone else scoop the litter" is strictly followed (i.e., a household member other than the pregnant woman cleans the litter box daily); if a pregnant woman must clean it herself, she must wear gloves and wash her hands thoroughly. This behavioral guideline—often called the "litter box hygiene guideline"—can effectively protect high-risk individuals. Similarly, for immunocompromised individuals, it is essential to emphasize protective measures such as avoiding direct contact with cat litter and wearing gloves while gardening. Precise, evidence-based guidance from veterinarians is key to dispelling unnecessary fear of cats while ensuring that risks remain under control [5].

Fourth, guidance on environmental disinfection. Veterinarians should provide precise disinfection protocols for *Toxoplasma* oocysts and inform owners of the fact that conventional disinfectants are largely ineffective. Effective methods for disinfecting the home environment include regularly scalding litter boxes with boiling water (above 60°C), using steam cleaners on areas frequented by the cat, and subjecting fabrics and bedding to high-temperature drying or prolonged exposure to direct sunlight. Such specific, actionable guidance on environmental management addresses a critical weak link in the current chain of household *Toxoplasma* prevention and control.

### 3.3. Cross-sectoral collaboration mechanism from a One Health perspective

A veterinarian-led prevention and control model does not imply that veterinarians are working in isolation. On the contrary, given their unique position at the front line of infectious disease sources, veterinarians should serve as initiators of interdisciplinary collaboration and as information hubs—a role that embodies the "One Health" concept in practical *Toxoplasma* control.

The "veterinarian-physician" linkage mechanism serves as a primary channel for inter-sectoral collaboration. When a veterinarian clinically confirms an active *Toxoplasma* infection in a cat—particularly cases testing positive via PCR or IgM, which indicate recent infection and oocyst shedding [12]—a standardized notification and referral process should be initiated. Specifically, the veterinarian should provide the cat owner with a written notice detailing the cat's infection status and potential zoonotic risks. The owner and household members—especially pregnant women, pregnancy-planning women, and immunocompromised individuals [13]—should then take the veterinarian-issued "Notice of Exposure to Animal-Source *Toxoplasma*" to a medical facility for consultation with specialists on serological screening and risk assessment. This mechanism transforms diagnostic findings from the veterinary sector into proactive health alerts for humans, thereby facilitating the seamless flow of health information across species [10].

The "veterinarian–environment/community" collaborative mechanism expands prevention and control from individual pet-owning households to public spaces. By leveraging regional data on *Toxoplasma* infections in cats—gathered through routine clinical practice and stray cat rescue efforts—community veterinary clinics can identify high-risk areas for environmental *Toxoplasma* contamination (such as zones with high stray cat activity, communal sandpits, and areas surrounding children's playgrounds). Veterinarians and their institutions should proactively propose environmental sanitation interventions to community management authorities; examples include covering public sandpits when not in use and periodically replacing the sand, cleaning and disinfecting stray cat gathering spots, and collaborating on community-led TNR (Trap-Neuter-

Return) programs to control the source of infection. This approach turns veterinary surveillance data into a scientific basis for community environmental management.

**Integration of Collaborative Processes:** The above mechanisms require clear process design to work effectively. An ideal collaborative workflow positions the community veterinary clinic as the hub for information and action: upon diagnosing a cat with *Toxoplasma* infection, the veterinarian simultaneously initiates two pathways—advising the owner to consult a human physician (collaboration with the human healthcare sector) and reporting regional risk data to community environmental management authorities (collaboration with environmental management). Conversely, when a physician consults a pregnant patient regarding *Toxoplasma* infection and learns of a history of cat ownership, they can recommend seeking an infection status assessment for the cat from a partner veterinarian in the community. This bidirectional flow and proactive collaboration mechanism transform the veterinarian from a traditionally passive service provider into an organizer and central coordinator within the community-wide *Toxoplasma* prevention and control network.

#### 4. Conclusions

This study systematically demonstrates the necessity and feasibility of establishing a veterinarian-led community-based prevention and control system for *Toxoplasma gondii*. Using the "One Health" framework, the study analyzes key risk points within the "cat–environment–human" transmission chain and establishes the cat's central role as the definitive host in environmental contamination, and highlights the irreplaceable function of veterinarians in diagnostic surveillance, management of infection sources, and preventive education. Building on this, the study develops a veterinarian-led, closed-loop prevention and control strategy comprising four modules—diagnostic surveillance, treatment management, prevention systems, and inter-sectoral collaboration. By positioning veterinarians as initiators and information hubs for community-level *Toxoplasma* control, this approach addresses the structural absence of the veterinary role in current models that rely primarily on passive health education delivered by human medical professionals.

In the future, the implementation of this strategic framework requires breakthroughs in several key areas: first, establishing a network of sentinel sites for *Toxoplasma* monitoring in veterinary clinics to enable the systematic accumulation of regional infection data among cat populations and facilitate dynamic early warning; second, creating a standardized information-sharing mechanism between veterinary and human medical sectors to translate veterinary diagnoses into proactive health alerts for the human population; third, intensifying the research and development of veterinary anti-*Toxoplasma* drugs and vaccines to address the current limitations in treatment options; and fourth, integrating this strategy into the primary public health service system, thereby institutionalizing the veterinary public health function through policy guidance and industry standards. Only through these measures can we achieve a true paradigm shift in *Toxoplasma* control—moving from reactive responses to proactive interventions, and from individual clinical treatment to community-wide health management.

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