Introduction

Zoonoses are defined as those diseases and infections that are naturally transmitted between humans and vertebrate animals (1,2). Presently, there are over 300 zoonotic diseases of diverse etiologies that occur in both sexes, all age groups, and in all seasons (2). Dogs and cats act as the reservoirs of a large number of parasitic zoonoses, including toxoplasmosis, giardiasis, leishmaniasis, toxocarasis, and cryptosporidiosis. The roles of pet animals (cats and dogs) in transmitting human infections have been recognized worldwide. Since most of these parasites have an oral-fecal transmission cycle, the transmission of these zoonotic agents could occur through indirect contact with animal feces, contaminated water, and food, or direct contact with infected animals. In addition, the soil is an important route for the transmission of human pathogens. In socioeconomically disadvantaged communities, the poor levels of hygiene and overcrowding, together with a lack of veterinary attention and zoonotic awareness, exacerbate the risks of disease transmission. Traditional husbandry and inadequate management practices, the mixing of wild animals with farm animals, and unrestricted movement and living pastoralists with their animals can all contribute to the development of zoonotic diseases. Therefore, veterinarians are thought to be on the ‘front line’ of the prevention of pet animal-associated zoonotic parasitic infections.

Keywords: Parasite, Pet animal, Public health, Transmission, Zoonotic infections
number of companion animals, there is more contact between domestic animals and people, exposing humans to zoonotic agents (15). In the absence of proper care, the link between humans, animal populations, and the surrounding environment can lead to a serious risk to public health with huge economic consequences. Therefore, this paper aims to review the major zoonotic parasites of pet animals.

**Cestodes**

*Echinococcus granulosus*

The burden of cystic echinococcosis (CE) caused by *E. granulosus*, both in terms of monetary burden and/or disability-adjusted life years (DALYs), has been estimated in many countries worldwide (16). Globally, it exceeds 1 million DALYs and 1 billion dollars per year (17). In many areas, the local burden of CE is significant; Echinococcosis may be one of the most common causes of disease burden in some rural nomadic pastoralist populations such as those in western China (18).

Large wild canids are susceptible to *E. granulosus* and can significantly contribute to disease epidemiology and zoonotic transmission. Human CE belongs to one of the five most frequently diagnosed zoonoses in the Mediterranean and is re-emerging in the endemic areas of south-eastern Europe (19).

*Echinococcus multilocularis*

Humans and dogs are accidental hosts (20). Alveolar echinococcosis is one of the most severe (lethal) parasitic zoonoses in Europe and worldwide in the northern hemisphere, with highly serious clinical implications and a high burden of disease (21). Clinical manifestations in humans include enlarging alveolar or liver cysts or brain often fatal (5).

The contribution of cats to the transmission of *E. multilocularis* may not be as significant as once believed, they are extremely less susceptible to infection with the parasite than canids (22). Unlike cats, domestic and raccoon dogs excrete comparable large numbers of *E. multilocularis* eggs (23). The prevalence of *E. multilocularis* infection is usually lower in dogs, they can substantially contribute to environmental contamination by parasite eggs, given their high population density, particularly in urbanized areas (24).

**Opisthorchiidae**

Opisthorchiidae is a group of fish-borne zoonotic trematodes that includes the liver flukes *Opisthorchis felineus*, *Opisthorchis viverrini*, and *Clonorchis sinensis*. The life cycle of the liver flukes is complex and indirect; immediately following the excretion of embryonated eggs with the feces of the definitive host in a freshwater environment, they infect and hatch within Bithynia snails, the first intermediate host. Free-living cercariae are released into the environment after a time of asexual reproduction in the snail and consumed by a fish of the family Cyprinidae (the second intermediate host), where they mature into metacercariae (25). Humans are used as the definitive hosts, and cats and dogs are employed as reservoir hosts. Humans are infected by the consumption of undercooked fish containing viable metacercariae, and the infection induces hepatobiliary pathology that eventually leads to bile duct cancer, cholangiocarcinoma (CCA), the leading cause of death in Asia. *O. viverrini* and *C. sinensis* are known as type 1 carcinogenic agent because of their strong association with CCA (26).

Up to 700 million (10% of the global population) are at risk of infection with *O. felineus* (27). It provides to the global disease burden in terms of DALYs and reflects a substantial impact on the health and well-being of the infected victims in developing countries (28). Infection by the liver fluke causes various non-specific gastrointestinal (GIT) symptoms in some infected individuals, which are related to the intensity of the infection. In *C. sinensis* alone, an estimated 2.5 million people may have some form of illness (29).

CCA has a high case fatality rate, and the district-based prevalence of CCA in opisthorchiiasis endemic areas, including northeast Thailand, ranged from 90 to 300 per 100 000. Regardless of surgical treatment, most CCA cases have a poor prognosis, and the survival rate also varies with the stage of cancer and the healthcare system. The greatest CCA patients survive for less than 5 years (30).

**Nematodes**

**Hookworms**

*Ancylostoma caninum* and *Uncinaria stenocephala* are the cosmopolitan hookworms of the intestine of dogs and other canids. Female hookworms excrete morphologically similar thin-shelled eggs, which are passed in the feces of the host, completing the parasitic nematode’s life cycle. Under suitable environmental conditions (23-33°C), the ‘rhabditiform’ L1s hatch from the eggs. The L1s feed on bacteria and molt to L2s in 2 days, then to L3s in 4-5 days. This latter stage retains the cuticle of the L2 (sheath) and is referred to as a ‘filariform’ larva. Although the larvae of *U. stenocephala* mature into adult males and females in the small intestine of vertebrate hosts, those of *A. caninum* enter subcutaneous tissues and migrate via the circulatory system to the heart and lungs, where they molt to fourth-stage larvae (31-33). The larvae move from the lungs to the small intestine (through the trachea and pharynx), where they grow into adult males and females in 2-7 weeks, depending on the species (Figure 1).

The pathogenesis of hookworm disease is mainly a consequence of blood loss, which is caused by tissue damage and direct ingestion of red cells by the adult worm (34). Occasionally, the migration of *A. caninum* larvae through human skin may cause cutaneous larva
migrants, also known as “creeping eruptions” (35).

**Dirofilariasis**
Dirofilariasis caused by *Dirofilaria immitis* and *D. repens* are the most important members, being a common parasite of domestic carnivores, including dogs and cats, but also of other hosts such as wild carnivores and humans (36). Adult *D. immitis* worms are found in the pulmonary arteries and right heart chambers, causing canine and feline heartworm disease, while *D. repens* is found primarily in subcutaneous tissues and causes subcutaneous dirofilariasis (37). Aberrant migrations with ectopic localizations (body cavities, central nervous system, and eye) for both *Dirofilaria* spp. (38).

*Dirofilaria immitis* has a prepatent time of 120-180 days, while *D. repens* has a prepatent period of 189-259 days. Both species’ adult females deposit embryos (microfilariae) into the mammalian host’s blood, and these parasites have five larval stages that develop in an intermediate mosquito host (from embryo to infective L3) that also serves as a vector and in a definitive vertebrate host (from L3 to the adult stage). Mosquitoes become infected by feeding on a microfilariae host’s blood (37). *Aedes vexans*, *Culex pипiens*, and *Aedes albопictus* are implicated as the main natural vectors of these worms (39).

Because of its pathogenicity in companion animals, interest in dirofilariasis was mostly directed at *D. immitis* until a few years ago. However, as the spread of *Dirofilaria* diseases, particularly *D. repens*, has increased in Eastern and Northern European countries, veterinarian awareness and perception have increased as well (40). In addition, both *Dirofilaria* species are zoonotic, and human cases of *D. repens* infection are on the rise in Europe (41).

**Protozoan Parasites**

**Leishmaniases**
Leishmaniases are infectious diseases that affect humans, domestic animals, and wild animals all over the world and are caused by *Leishmania* spp. (42). The majority of zoonotic transmission cycles involve reservoir hosts such as rodents, marsupials, edentates, monkeys, domestic dogs, and wild canids. Most *Leishmania* spp. that infect humans are zoonotic, and only a few are strictly anthroponotic (directly transmitted from humans to humans by sandflies). *Leishmania infantum* causes visceral leishmaniasis (VL) transmitted by sandflies from the major reservoir of domestic dogs (43). Canine and human *L. infantum* infections are spread primarily through dogs in an area that stretches from Portugal to China and across South, Central, and parts of North America. In North America, cutaneous leishmaniasis (CL) is endemic within south-central Texas and appears to be spreading northward into the Dallas-Fort Worth metro area, affecting humans, cats, and dogs (44).

The proven modes of non-sandfly transmission include infection through transfused blood products from blood donors which are the carriers of infection, venereal and vertical transmission (45-47). The estimated incidence accounts for 2 million new cases per year, 0.5 million VL, and 1.5 million CL (48). In Europe and Mediterranean countries, about 1,000 people are estimated to be affected by clinical disease annually (49), although asymptomatic or sub-clinical cases are by far more frequent. The prevalence of 2%-40% of the asymptomatic human carriers of *L. infantum* in southern Europe suggests that this parasite is a latent public health threat. Asymptomatic cases are also estimated at a ratio of > 100 asymptomatic clinical cases (50). Mortality rates in human immunodeficiency virus (HIV)-infected patients can reach over 56% (51).

**Toxoplasmosis**
Toxoplasmosis is an important protozoan zoonosis of global public health importance and is caused by *Toxoplasma gondii* which has a complex life cycle (52). The development of *T. gondii* occurs asexually in various tissues of herbivorous or omnivorous intermediate hosts and is related to a sexual phase of development in the gut of felids, the final hosts. Tachyzoites, bradyzoites contained in tissue cysts, and sporozoites contained in sporulated oocysts are the three infectious stages of the parasite’s life cycle. The parasite can invade the gut, become systemic, and localize in vital organs such as muscles and nervous system tissues. In most cases, infection is asymptomatic, but the devastating disease can occur (53).

Felids are definitive hosts for *T. gondii*, but all warm-blooded vertebrates (including humans) may behave as intermediate hosts and potentially be infected by bradyzoites in meat, sporulated oocysts, or tachyzoites intrauterine (4). The parasite *T. gondii* has become adapted to exploit multiple routes of transmission through a sexual cycle in the definitive hosts (felids) and asexually, through carnivorous behavior, and transmitted vertically.
by tachyzoites passed to the fetus via the placenta (54).

Congenital toxoplasmosis causes around 2300
DALYs per year in the Netherlands (55). Furthermore,
toxoplasmosis is a well-known consequence of HIV
infection, and acquired toxoplasmosis can cause
chorioretinitis. It is increasingly being connected
to neurological and psychological problems such as
epilepsy, migraine, and schizophrenia (56). Ocular
toxoplasmosis is a progressive and recurring necrotizing
retinitis, with vision-threatening complications such as
retinal detachment, choroidal neovascularization, and
glaucoma (57).

Although seroprevalences are decreasing in many
regions of the world, there is currently little that can
be performed to control or eliminate this disease (58),
possibly linked to increased living standards. In addition,
with the increased intensification of the pork industry,
there is a lower prevalence of pork, with a lower risk
of transmission to humans (59). At least, in theory,
transmission could be ameliorated by testing meat for
toxoplasmosis, and ensuring infected meat is frozen to
destroy the bradyzoites before consumption (60).

Giardiasis

Giardiasis is an emerging protozoan disease that is
common in warm climates (61). The host range of Giardia
species varies significantly, with Giardia duodenalis
having the largest host range and the greatest public
health importance (62). Historically, allozyme analysis
divided all human isolates into two genetic categories
( assemblies A and B ). Multigenic sequence analyses
confirmed this assemblage separation and identified
additional lineages of G. duodenalis from animal
assemblages C and D from dogs, assemblage E from
artiodactyls, assemblage F from cats, assemblage G from
rodents, and assemblage H from marine vertebrates (63).

Giardia has a direct life cycle, and the parasite’s infective
stage, the cyst, becomes encysted and infectious as soon
as it is released into the feces. Cysts can live for months
in cool and damp environments and remain infectious.
Cysts excyst in the duodenum after being consumed by
the host releasing the trophozoites. The latter undergoes
several mitotic divisions and forms cysts that are resistant
to the environment. Cysts pass through the intestine in
feces and are spread by contaminated water, food, and
fomites and by direct physical contact (2,62).

Giardia infection in animals is often asymptomatic
but has been associated with the occurrence of diarrhea
and ill-thrift in puppies and kittens (64). It is commonly
believed that infection with Giardia is related to economic
losses through the occurrence of diarrhea, poor growth,
and death (65).

Cryptosporidium

Cryptosporidium parvum of bovine, but not human, the
origin can infect dogs (66), a human and his dog were
found to have different genotypes in Japan. In Osaka
respectively, all genetic isolates from dog feces were
of Cryptosporidium canis, which is thought to be non-
pathogenic in humans (67).

However, the dog strain has been recovered from 1
out of 1680 patients with cryptosporidiosis in England
(68), and an HIV-infected human in America (69).
Infection in immunocompetent people is regarded as
moderate and self-limiting, which sharply contrasts with
the prolonged severe diarrhea in immunocompromised
patients (70). Cryptosporidium occurred in the dog in
Colorado (3.8%) (71).

Epidemiology of Zoonotic Gastrointestinal Parasites
in Pet Animals

Globally, there is significant variation in the prevalence
of GIT parasites present in dogs and cats with the percentage
ranging between 26% and 96% (12). The high prevalence
of GIT helminth in dogs and cats in Brazil ranges between
88% and 90% (15). Likewise, the GIT helminths in rural
dogs in Argentina represented prevalence rates ranging
from 37.9% to 52.4% (9).

The high prevalence of hookworm infections among
dogs and cats in rural communities can play a significant
role in the occurrence of zoonotic ancylostomiasis such
as creeping eruption and eosinophilic enteritis or less
frequent symptoms of localized myositis, erythema
multiform, and ophthalmological manifestations in
human (35).

The role of dogs and cats in the transmission of Ascaris
lumbricoides to humans is well recognized. Ascaris from
positive dogs is 100% homology with A. lumbricoides
derived from the human fecal sample using molecular-
based tools in India. The dog that tested positive for
Ascaris belonged to a family that included at least one
member afflicted with A. lumbricoides (72).

Giardia and Cryptosporidium are among the potential
zoonotic protozoan parasites of dogs and cats that are
infective humans. Some Giardia genotypes, particularly
assemblage A, can be infective for both human and
animal hosts (73). Similarly, the zoonotic potential of Cryptosporidium spp. is well known, and domestic
animals are an important reservoir of infection for
humans (74). Overall, 16 different Cryptosporidium spp.
and over 40 genotypes with new genotypes have been
identified regularly (75).

Transmission of Zoonotic Parasite
Contaminated Food and Water

Toxoplasma gondii is the most important pathogen
transmitted by food in the USA and possibly Europe (76).
Many human infections are thought to be spread by eating
raw or undercooked meat such as pork or lamb. However,
the high prevalence of T. gondii infection in people who
do not eat meat or eat it raw demonstrates that infection through the environment (e.g., oocysts in soil, water, or uncooked vegetables) could also be a factor. Only a small proportion (less than 0.1%) of people acquire infection congenitally (77).

Developments in the molecular and genetic analyses of waterborne protozoan parasites, including the determination of species identity and subtyping species, will help in determining the contributors to environmental contamination. Several genotyping techniques have been developed for Cryptosporidium, Giardia, Microsporidia spp., and Toxoplasma (61,78). The small size of Microsporidia (1-5 mm) makes them difficult to remove using conventional water filtration techniques, and there is concern that they may possess increased resistance to chlorine disinfection similar to Cryptosporidium. The spores may be susceptible to disinfection (79).

Soil-transmitted

Toxocara canis is transmitted to humans mainly by the incidental ingestion of embryonated eggs present in the soil or soil-contaminated food (2,3,80). Most eggs (51%-95%) recovered from the soil of temperate countries were fully embryonated and, therefore, infective (81). Although larvae may not develop further, parasites can live for up to seven years following infection (Figure 2). Moreover, direct contact with sick puppies and kittens is not typically thought to be a risk factor for human toxocariasis because the eggs shed by these animals must be embryonated in the soil before becoming infective, and these pets may contain embryonated eggs in their fur (82).

Zoonotic Risk

Pet Ownership

Pet ownership is an important risk factor for the occurrence of toxoplasmosis (4). The low schooling level of owners has been regarded as a risk factor for the occurrence of zoonotic gastrointestinal parasites (Ancylostoma, Uncinaria, Toxocara spp, G. duodenalis, and T. gondii) in dogs and cats (83). Among intestinal protozoa, Cryptosporidium spp. is prevalent in people with congenital or acquired immunodeficiency, including patients with acquired immunodeficiency syndrome (61,84).

Management Practices

The important factor that was found to be associated with helminthosis was dog management concerning the degree of house confinement. Dogs that roam freely had a higher prevalence (92.5%) of helminthosis than dogs confined within the premises of their owners (64.5%). Similarly, a higher prevalence (97.34%) of helminthosis was documented for stray dogs in Hawassa as compared to confined dogs (69.6%) (85).

The majority of animal health professionals are knowledgeable about the source of infection, transmission, treatment, control, and prevention of animal-borne zoonotic diseases. However, due to a lack of joint work and programs with medical professionals, none of them had ever identified the disease in animals or attempted to teach the community. On the other hand, the majority of medical professionals have limited knowledge of zoonoses, and none of them had ever diagnosed zoonotic diseases such as toxoplasmosis, hydatidosis, and the like in humans; the reason for the diagnosis problem was the lack of facility, and no attention was given to the diseases next to a lack of awareness (86).

Prevention and Control of Zoonotic Parasites

Controlling infections by soil-transmitted helminths requires the prophylactic deworming of companion animals regularly, as well as educational programs directed at pet owners. In addition, veterinarians' perception concerning small animal-derived zoonosis should be improved, with an emphasis on their role in disseminating information about these diseases to their clients. In Canada, 80-90% of the protocols recommended for puppies and kittens were inappropriate (87). Veterinarians are also thought to be on the 'front line' of the prevention of pet-associated zoonotic parasitic infections (3). In southeastern Brazil, a significant decrease was observed in the incidence of a cutaneous larval migrant after the replacement of the soil in sandboxes and the enclosure of playground areas with fences (88,89). Similarly, in Turkey, fenced parks were free of Toxocara eggs, while 64.3% of open areas were contaminated with eggs (90-92). Although domestic dogs are more likely to undergo regular deworming treatments, restricting the spread of the virus to wild carnivores populations, feral dog populations play an important role in the contamination of the environment by Toxocara eggs, thus
effectively acting as a “bridge” between domestic and wild host populations (83,93). Control of stray dogs and dog deworming campaigns are of vital significance for the control of these zoonotic diseases (61,94,95).

Conclusion and Recommendations

The zoonotic parasites of pet animals are the most important diseases, which are distributed throughout the world. In the absence of proper care, the link between humans, animal populations, and the surrounding environment can lead to a serious risk to public health with huge economic consequences. The potential for the zoonotic transmission of intestinal helminths and the human health risks associated with dog and cat ownership is now increasing from time to time, thus there is an urgent need to obtain more recent and up-to-date information on the zoonotic parasites of dogs and cats for better designing appropriate control and prevention strategies. These recommendations are based on the above-mentioned conclusion:

- Companion animals should be dewormed regularly, and pet owners should be educated.
- There is a need to have stray dog control and dog deworming programs throughout the world.
- Veterinarians are also thought to be on the ‘front line’ of the prevention of pet-associated zoonotic parasitic infections.

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References

18. Budke CM, Jinam Q, Zinsstag J, Qian W, Torgerson PR. Use of disability adjusted life years in the estimation of the disease burden of echinococcosis for a high endemic region of the


42. Anderson RC. Nematode Parasites of Vertebrates: Their Development and Transmission. CABI; 2000.


Flegler, Pradonna J, Sovickova, M, Issari, ZH. Toxoplasmosis—
a global threat. Correlation of latent toxoplastic disease

Kortbeek, LM, Hofhuis A, Njihuis CD, Havelaar AH. Congenital
toxoplasmosis and DALYS in the Netherlands. Mem Inst Oswaldo

Torrey EF, Barkow JJ, Yolkon RH. Toxoplasma gondii and other
risk factors for schizophrenia: an update. Schizophr Bull.

10.3347/kjp.2013.51.4.393.

Pappas G, Roussos N, Falagas ME. Toxoplasmosis snapshots:
global status of Toxoplasma gondii seroprevalence and
implications for pregnancy and congenital toxoplasmosis. Int J
ijpara.2009.04.003.

Davies PR. Intensive swine production and pork safety. Foodborne Pathog Dis. 2011;8(2):189-201. doi:
10.1089/fpd.2010.0717.

Kijlstra A, Jonger E. Foodborne Pathog Dis. 2011;8(2):189-201. doi:

Thompson RC, Palmer CS, O’Handley R. The public health
implications for pregnancy and congenital toxoplasmosis.
BMJ. 2000;321(7254):127-8. doi:
10.1136/bmj.321.7254.127.24.

Lindsay DS, Dubey JP. Sources of Toxoplasma gondii infection
in pregnancy. Until rates of congenital toxoplasmosis fall,

Santarém VA, Rubinsky-Elefant G, Ferreira MU. Soil-
transmitted helminthic zoonoses in humans and associated
risk factors. In: Pasucci S, ed. Soil Contamination. Rijeka:
IntechOpen; 2011. p. 43-66. doi:
10.5772/23376.

Jarosz W, Mizgajski-Wiktork H, Kirwan P, Konarski J, Ryckliwicki
W, Wawrzynekia G. Developmental age, physical fitness
and Toxocara seroprevalence amongst lower-secondary
students living in rural areas contaminated with Toxocara
s0304-4017(01)00575-1.

Lindsay DS, Dubey JP. Unusual zoonotic transmission of
Cryptosporidium from human faeces: first description of

10.1645/CJ-01141.2.


Hackett T, Lappin MR. Prevalence of enteric pathogens in

Traub RJ, Robertson ID, Irwin P, Mencke N, Monis P, Thompson
RC. Humans, dogs and parasitic zooneses—unraveling the
relationships in a remote endemic community in northeast
India using molecular tools. Parasitol Res. 2003;90 Suppl


Xiao L, Fayer R, Yuan U, Upton SJ. Cryptosporidium

Ng J, Eastwood K, Durrheim D, Massey P, Walker B, Armson
A, et al. Evidence supporting zoonotic transmission of
Cryptosporidium in rural New South Wales. Exp Parasitol.

Dubey JP. Sources of Toxoplasma gondii infection in
pregnancy. Until rates of congenital toxoplasmosis fall,

Lindsay DS, Dubey JP. Toxoplasma gondii: the changing
paradigm of congenital toxoplasmosis. Parasitology.

Orandi PA, Lampel KA. Extraction-free, filter-based template
preparation for rapid and sensitive PCR detection of pathogenic

Wolik DM, Johnson CH, Rice EW, Marshall MM, Grahm KF,
Plummer CB, et al. A spore counting method and cell culture
model for chlorine disinfection studies of Encephalitozoon

Gebremichael D, Feleke A, Tesfamaryam G, Awel H, Tsigab Y.
Knowledge, attitude and practices of hydatidosis in pastoral

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W, Wawrzynekia G. Developmental age, physical fitness
and Toxocara seroprevalence amongst lower-secondary
students living in rural areas contaminated with Toxocara
s0304-4017(01)00575-1.

Lindsay DS, Dubey JP. Toxoplasma gondii: the changing
paradigm of congenital toxoplasmosis. Parasitology.

Orandi PA, Lampel KA. Extraction-free, filter-based template
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Wolik DM, Johnson CH, Rice EW, Marshall MM, Grahm KF,
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model for chlorine disinfection studies of Encephalitozoon

Gebremichael D, Feleke A, Tesfamaryam G, Awel H, Tsigab Y.
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