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## Parasitic Agents

### Agent: Blood and Tissue Protozoal Parasites of Humans

Laboratory-associated infections with *Plasmodium* spp. (including *P. cynomolgi*); *Trypanosoma* spp.; and *Leishmania* spp. have been reported. <sup>(1)(2)(3)(4)(5)(6)(7)(8)(9)(10)(11)(12)</sup>

Although no laboratory infections with *Babesia* spp. have been reported, they could result from accidental needlestick or from the bite of an infected tick. Although laboratory animal-associated infections are not common, mosquito-transmitted malaria infections do occur. Other potential direct sources of infection for laboratory personnel include contact with lesion material from rodents with cutaneous leishmaniasis, and contact with feces or blood of animals or insects experimentally or naturally infected with *T. cruzi*. <sup>(13)</sup>

**Laboratory Hazards:** Infective stages may be present in blood, feces, cerebrospinal fluid (CSF), bone marrow, or other biopsy tissue, lesion exudates, and infected arthropods. Depending on the parasite, the primary laboratory hazards are ingestion, skin penetration through wounds or microabrasions, accidental parenteral inoculation, and transmission by arthropod vectors. Aerosol or droplet exposure of organisms to the mucous membranes of the eyes, nose, or mouth are potential hazards when working with cultures of *Leishmania* spp., *T. cruzi*, or with tissue homogenates or blood containing hemoflagellates. Immunocompromised individuals should avoid working with live organisms.

**Recommended Precautions:** Biosafety Level 2 practices and facilities are recommended for activities with infective stages of the parasites listed. Infected arthropods should be maintained in facilities which reasonably preclude the exposure of personnel or their escape to the outside. Primary containment (e.g., biological safety cabinet) or personal protection (e.g., face shield) may be indicated when working with cultures of *Leishmania* spp., *T. cruzi*, or with tissue homogenates or blood containing hemoflagellates. <sup>(14)(15)</sup>

Gloves are recommended for activities where there is the likelihood of direct skin contact with infective stages of the parasites listed. Appropriate treatment for most protozoal infections exists, and information on dosage, source of drugs, etc., is available. <sup>(16)</sup>

**Transfer of Agent:** For a permit to import these agents, contact CDC.

### Agent: Intestinal Protozoal Parasites of Humans

Laboratory-associated infections with *Toxoplasma* spp.; *Entamoeba* spp.; *Isospora* spp.; *Giardia* spp.; *Sarcocystis* spp.; and *Cryptosporidium* spp. have been reported. <sup>(17)(18)(19)(20)(21)</sup>

No laboratory infections with microsporidia have been reported, but they could result from ingestion of spores in feces, urine, sputum, CSF, or culture.

Laboratory animal-associated infections have been reported and provide a direct source of infection for laboratory personnel who come in contact with feces of experimentally or naturally infected animals. In the case of rodents experimentally-inoculated with *Toxoplasma* via the intraperitoneal route, contact with peritoneal fluid could result in exposure to infectious organisms.

Laboratory-related infections with *Cryptosporidium* have occurred with regularity in almost every laboratory working with this agent, especially those in which calves are used as the source of oocysts. Other experimentally infected animals pose potential risks as well. Circumstantial evidence suggests that airborne transmission of oocysts of this small organism may occur. Rigid adherence to protocol should reduce the occurrence in laboratory and animal care personnel.

*Laboratory Hazards:* Infective stages may be present in the feces or other body fluids and tissues. Depending on the parasite, ingestion is the primary laboratory hazard. Aerosol or droplet exposures of the mucous membranes of the eyes, nose, or mouth to trophozoites could pose potential hazards when working with cultures of free-living amoeba, such as *Naegleria fowleri*, *Acanthamoeba*, or *Balamuthia*, but the level of risk is unknown.

Immunocompromised individuals should avoid working with live organisms. Because of the grave consequences of toxoplasmosis in the developing fetus, serologically negative women of childbearing age who might become pregnant should receive extensive counseling from a well-informed laboratory supervisor about the potential risks to the fetus. Fully informed employees who choose not to be exposed should be provided with alternative assignments in a work area where viable *Toxoplasma* organisms are not being handled. Working with infectious oocysts poses the greatest risk of acquiring infection; needle sticks with material containing tachyzoites or bradyzoites also pose a significant risk. Infection with tachyzoites or bradyzoites through mucous membranes or skin abrasions is also possible. Laboratories conducting studies only with killed or inactivated parasite materials, or parasite fractions, pose no significant risks.

*Recommended Precautions:* Biosafety Level 2 practices and facilities are recommended for activities with infective stages of the parasites listed. Primary containment (e.g., biological safety cabinet) or personal protection (e.g., face shield) may be indicated when working with cultures of *Naegleria fowleri*, or *Cryptosporidium*. Appropriate treatment for most protozoal infections exists, and information on dosage, source of drugs, etc., is available.<sup>(22)</sup>

*Transfer of Agent:* For a permit to import these agents, contact CDC.

### **Agent: Trematode Parasites of Humans (*Schistosoma* spp. and *Fasciola* spp.)**

Laboratory-associated infections with *Schistosoma* spp. and *Fasciola* spp. have been reported. None have been directly associated with laboratory animals, with the exception of infected mollusk intermediate hosts.<sup>(23)(24)(25)(26)</sup>

*Laboratory Hazards:* Infective stages of *Schistosoma* spp. (cercariae) and *Fasciola* spp. (metacercaria) may be found, respectively, in the water or encysted on aquatic plants in laboratory aquaria used to maintain snail intermediate hosts. Skin penetration by schistosome cercariae and ingestion of fluke metacercaria are the primary laboratory hazards. Dissection or crushing of schistosome-infected snails may also result in exposure of skin or mucous membrane to cercariae-containing droplets. Additionally, metacercaria may be inadvertently transferred from hand to mouth by fingers or gloves, following

contact with contaminated aquatic vegetation or surfaces of aquaria. Most laboratory exposures to *Schistosoma* spp. would predictably result in low worm burdens with minimal disease potential. Safe and effective drugs are available for the treatment of schistosomiasis.

*Recommended Precautions:* Biosafety Level 2 practices and facilities are recommended for activities with infective stages of the parasites listed. Gloves should be worn when there may be direct contact with water containing cercariae, or vegetation containing metacercaria from naturally or experimentally infected snail intermediate hosts. Long-sleeved laboratory coats or other protective garb should be worn when working around aquaria or other water sources that may contain schistosome cercariae. Snails and cercariae in the water of laboratory aquaria should be killed by chemicals (e.g., hypochlorites, iodine) or heat before discharge to sewers. Appropriate treatment for most trematode infections exists, and information on source of drugs, dosage, etc. is available.<sup>(27)</sup>

*Transfer of Agent:* For a permit to import these agents, contact CDC.

**Agent: Cestode Parasites of Humans - *Echinococcus granulosus*, *Taenia solium* (*Cysticercus cellulosae*) and *Hymenolepis nana*.**

Although no laboratory-associated infections have been reported with either *E. granulosus* or *T. solium*, the consequences of such infections following the ingestion of infective eggs of *E. granulosus* or *T. solium* are potentially serious. *H. nana* is a cosmopolitan parasite which does not require an intermediate host and is directly transmissible by ingestion of feces of infected humans or rodents.

*Laboratory Hazards:* Infective eggs may be present in the feces of dogs or other canids (the definitive hosts of *E. granulosus*), or in the feces of humans (the definitive host of *T. solium*). Ingestion of infective eggs from these sources is the primary laboratory hazard. Cysts and cyst fluids of *E. granulosus* are not infectious for humans. Ingestion of cysts containing the larval stage of *T. solium* (*Cysticercus cellulosae*) readily produces human infection with the adult tapeworm. With either parasite, the ingestion of a single infective egg from the feces of the definitive host could potentially result in serious disease. Ingestion of the eggs of *H. nana* in the feces of the definitive host could result in intestinal infection.

*Recommended Precautions:* Biosafety Level 2 practices and facilities are recommended for work with infective stages of these parasites. Special attention should be given to personal hygiene practices (e.g., handwashing) and avoidance of ingestion of infective eggs. Gloves are recommended when there may be direct contact with feces or with surfaces contaminated with fresh feces of dogs infected with *E. granulosus*, with humans infected with *T. solium* adults, or with humans or rodents infected with *H. nana*. Appropriate treatment for many cestode infections exists, and information concerning source of drugs, dosage, etc., is available.<sup>(28)</sup>

*Transfer of Agent:* For a permit to import these agents, contact CDC.

### **Agent: Nematode Parasites of Humans**

Laboratory-associated infections with *Ascaris* spp.; *Strongyloides* spp.; hookworms; and *Enterobius* spp. have been reported.<sup>(29)(30)(31)</sup> Allergic reactions to various antigenic components of nematodes (e.g., aerosolized *Ascaris* antigens) may represent an individual risk to sensitized persons. Laboratory animal-associated infections (including arthropods) have not been reported, but infective larvae in the feces of nonhuman primates infected with *Strongyloides* spp. are a potential infection hazard for laboratory and animal care personnel.

*Laboratory Hazards:* Eggs and larvae in freshly passed feces of infected hosts are usually not infective; development to the infective stages may take periods of one day to several weeks. *Trichinella* is of concern since fresh or digested tissue may contain larvae and would be infective if ingested. Ingestion of the infective eggs or skin penetration of infective larvae are the primary hazards to laboratory and animal care personnel. Arthropods infected with filarial parasites pose a potential hazard to laboratory personnel. In laboratory personnel with frequent exposure to aerosolized antigens of *Ascaris* spp., development of hypersensitivity is common.

*Recommended Precautions:* Biosafety Level 2 practices and facilities are recommended for activities with infective stages listed. Exposure to aerosolized sensitizing antigens of *Ascaris* spp. should be avoided. Primary containment (e.g., biological safety cabinet) may be required for work with these materials by hypersensitive individuals. Appropriate treatment for most nematode infections exists, and information on dosage, source of drugs, etc. is available.<sup>(32)</sup>

*Transfer of Agent:* For a permit to import these agents, contact CDC.

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