IDAHO DEPARTMENT OF HEALTH & WELFARE

Disease Bulletin

- *Echinococcus granulosus*
- Rabies Vaccine
- Cryptosporidiosis in Idaho

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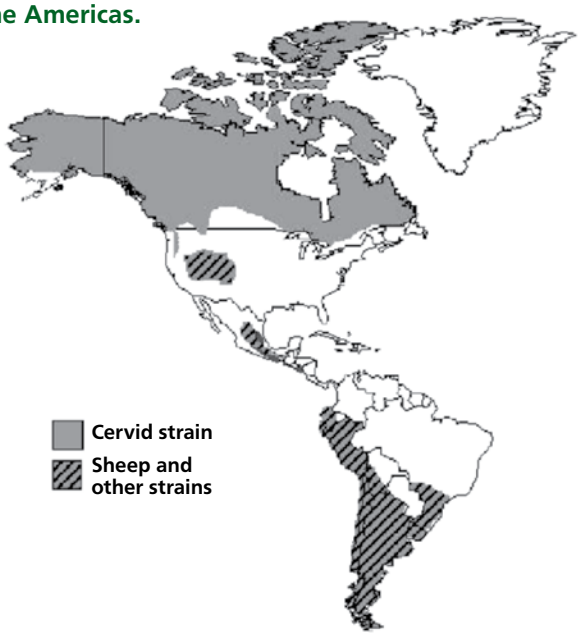
Echinococcus: Focus on Idaho

Echinococcus granulosus is a zoonotic, diminutive tapeworm that causes hydatid (unilocular) cyst disease in humans. *E. granulosus* occurs worldwide, including in many regions of the Americas (Figure 1). Several species of *Echinococcus* have been identified. Because *E. granulosus* is the species described in Idaho wildlife, this article will focus on the human health risks, clinical features, diagnosis, and management of hydatid cyst disease. In the continental United States, *E. granulosus* is found in holarctic tundra, boreal forest, other northern latitudes with favorable conditions, and in sheep husbandry areas of the western United States.

The majority of documented human infections in the United States have been acquired in endemic countries or in persons whose cultural practices allowed close contact with a definitive parasite host[1]. In 2009, Foreyt *et al*[2] reported finding *E. granulosus* in 62% of Idaho wolves evaluated between 2006 and 2008. *E. granulosus* was also detected in elk, deer, and a mountain goat. The authors consider this the first report of *E. granulosus* in a wildlife cycle in Idaho.

Echinococcus spp. have a complex two-host life cycle. Carnivores, the definitive host, and herbivores, the typical intermediate host, are required to complete the cycle (Figure 2). Definitive hosts shed in their feces eggs or gravid proglottids produced by adult worms residing in their gastrointestinal tract (GIT). The egg-containing feces may contaminate grazing grounds or local waterways. *E. granulosus* eggs survive for only short periods of time if they are exposed to direct sunlight and dry conditions, but may remain viable for several months under moist conditions and in moderate temperatures. Intermediate hosts consume viable eggs while grazing or drinking, initiating the second phase of the life cycle.

Figure 1. Approximate geographic occurrence of *Echinococcus granulosus*, agent of cystic echinococcosis, in the Americas.



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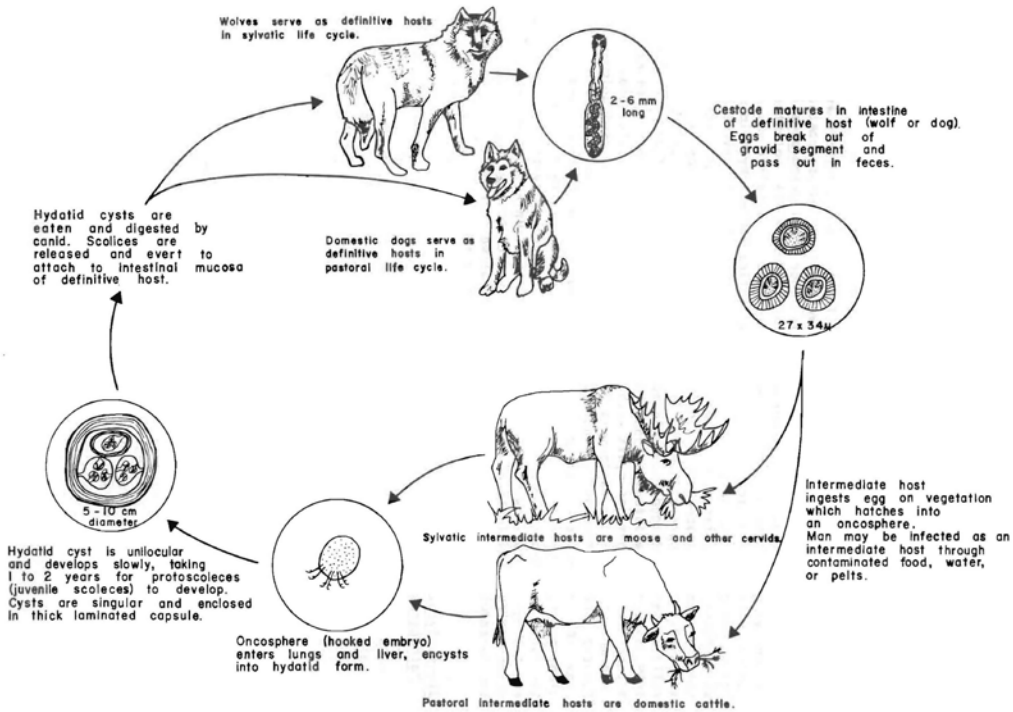
In this phase, the eggs hatch and larvae migrate throughout the body, eventually lodging in tissues, usually the lung or liver. The larvae reproduce, generating fluid filled brood cysts containing numerous immature parasites (protoscolices). The life cycle is complete when a definitive host consumes the brood cyst during predation of the intermediate host, allowing for the establishment of adult worms once again in the definitive host GIT. Intermediate hosts cannot transmit the parasite by casual contact. Eight defined strains (G1–3, G6–10) of *E. granulosus* have been described to date, often aligning with specific intermediate and definitive host cycles, morphology, and molecular characteristics[3]. Two *E. granulosus* life cycles have been described in the United States. The sylvatic (wild, or northern) (G8) cycle is maintained in nature generally between wild ungulates (*e.g.*, elk, mule deer, moose) which are the intermediate hosts, and wild canids (*e.g.*, wolves, coyotes) which are the definitive hosts. In the United States the sylvatic cycle is predominantly found in northern tier states, Alaska, and Canada. The synanthropic (G1) cycle is also known as the pastoral or domestic cycle. In this cycle, the parasite is maintained primarily between domestic dogs (*e.g.*, herding dogs) and sheep. Hydatid cysts were reportedly found in domestic sheep from Idaho that were sent to California for slaughter in the late 1960s and early 1970s[4].

Figure 2. Lifecycles of *Echinococcus* spp.



Reprinted from Dietrich RA (ed). *Alaska Wildlife Diseases.* University of Alaska Institute of Arctic Biology; 1981 with permission from the University of Alaska Institute of Arctic Biology.

Risk factors for human infection

Humans are considered incidental intermediate hosts.

- *Eggs shed by definitive hosts are considered infectious to humans*. Eggs are transmitted through the fecal-oral route by direct transfer of fecal material of canids or by consuming contaminated food or water.
- *Fertile (brood) cysts found in intermediate hosts are not considered a direct human health risk*. The greatest zoonotic disease risk from *E. granulosus* G8 and G1 strains appears to be associated with feeding working and domestic dogs (*e.g.*, sled dogs, herding dogs) affected tissues from intermediate hosts (*e.g.*, moose, caribou, elk, sheep), with subsequent peridomestic shedding of eggs and zoonotic transmission. Changes in cultural practices, including increased awareness of the parasite life cycle, hand hygiene and the elimination of feeding offal to dogs, have been documented to significantly reduce zoonotic disease transmission[5].

Incidence

Human echinococcosis is not reportable in most states in the United States, including Idaho. Because of this, the incidence of human infection in the United States is unknown. According to the Centers for Disease Control and Prevention (CDC), most documented cases in North America are diagnosed in immigrants or travelers returning from endemic countries, rather than in persons with no such history. Autochthonous transmission of *E. granulosus*, primarily of the sylvatic strain, has been reported rarely in Alaska[5,6]. Rare reports of locally-acquired human illness have also come from Arizona, California, New Mexico and Utah and were primarily of the sheep-associated pastoral strain and associated with cultural practices allowing working dogs to feed on sheep carcasses. *E. granulosus* has been present in Minnesota wolves for over thirty years. Surveillance data collected there have revealed no evidence of *E. granulosus* infection in humans or livestock (Dr. J. Scheftel, MN State Public Health Veterinarian, personal communication). In Idaho, human cases of hydatidosis are rarely reported.

Clinical illness in humans

E. granulosus causes hydatid disease, also known as hydatidosis, cystic echinococcosis or unilocular echinococcosis[1,8]. Infected persons may remain asymptomatic for many years or permanently. Many human infections are detected incidentally during imaging studies. Clinical manifestations are determined by the site and size of the slowly enlarging brood cyst. In approximately 90% of cases, cysts are located in the liver or lung; the remaining 10% could be found in any organ of the body, including brain, heart, and bones. Mass effect can cause a variety of conditions such as biliary, bronchial, or renal outflow obstruction. Allergic reactions, including anaphylaxis have been described, with cyst leakage or rupture. Clinical manifestations might be *Echinococcus* strain-dependent. G8 infections are characterized by predominantly pulmonary localization, slower and more benign growth, and less frequent

occurrence of clinical complications than reported for other forms[5].

Diagnosis

There is no standard, highly sensitive, and specific serological test for antibody detection in cases of human cystic echinococcosis. Seroconversion is poor in the absence of brood cyst leakage or rupture (CDC personal communication); therefore, serologic testing (which is commercially available) in the absence of suspicious imaging results has marginal sensitivity and predictive value and should be considered only as an adjunct method of diagnosis. Diagnosis usually requires ultrasound, CT, or MRI to detect the location of one or more brood cysts[1]. Diagnosis can also be confirmed by examining cyst tissue or contents for evidence of the parasite, but cyst rupture is a risk with this method. The Office of Epidemiology, Food Protection, and Immunization (OEFI) is available to discuss the epidemiologic features of any suspected case, and, upon prior approval, the Idaho Bureau of Laboratories, in association with the CDC, could assist in sample evaluation.

Treatment

Treatment options may include surgical removal of brood cysts and/or use of antiparasitic drugs such as albendazole or benzimidazole. Recent advances have included combination approaches, including albendazole initiation for one month followed by percutaneous aspiration of cyst contents and injection of a protoscolicidal agent, followed by re-aspiration. Consultation with an infectious disease or tropical medicine specialist for diagnosis and treatment is recommended.

Education and prevention

No human vaccine is available; therefore, education about avoiding parasite eggs is key to disease prevention, particularly for persons who might come in close contact with definitive hosts. Messages for your patients who hunt wolves or elk, or who have working sheepdogs or hunting dogs include:

- When handling feces, pelts, or carcasses from live or dead canines (including wolves) suspected to carry *Echinococcus* eggs, wear disposable gloves and thoroughly wash your hands after handling the material.
- Manage your pet and working dogs appropriately.
  - To avoid passive carriage of eggs, do not allow dogs to roll in wild canid feces.
  - To prevent dogs from becoming infected, do not allow them to consume internal organs from wild herbivores. *Echinococcus* cysts found in herbivores can infect dogs.
  - Once infected, dogs can be a source of infection to you and your family. If you think your dog might have been exposed, talk to a veterinarian about testing and treatment for your dog.
- Because fecal matter can contaminate food or water, use safe food and water practices in the field. Heat potentially contaminated food and water at 140º F (>60º C) for at least 30 minutes to destroy the eggs[1].

For more information on the disease in wildlife, visit the Idaho Department of Fish and Game web site: **http://fishandgame.idaho.gov/cms/wildlife/manage_issues/echinococcus.cfm**.

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3 Jenkins DJ, Romig T, Thompson RC. Emergence/re-emergence of Echinococcus spp.—A global update. *International Journal for Parasitology.* 2005; 35:1205–1219.

4 Idaho Department of Fish and Game Parasite Tapeworm – Echinococcus Granulosus Q and A, January, 2010 **http://fishandgame.idaho.gov/cms/wildlife/manage_issues/echinococcus.cfm**

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Rabies Post-exposure Vaccine Schedule Update

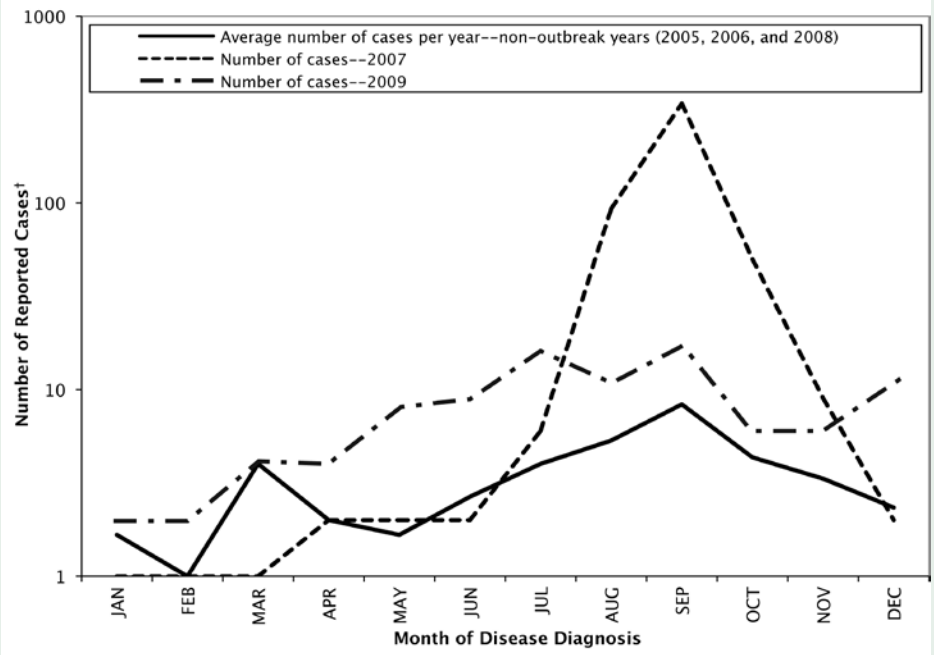
The Advisory Committee on Immunization Practices (ACIP) recently updated their recommendations for post-exposure prophylaxis (PEP) to prevent human rabies in immunocompetent persons. Previously, ACIP recommended a 5-dose rabies vaccination regimen. These new recommendations reduce the number of vaccine doses to four by eliminating the last dose in the series. The series now consists of doses at day 0, 3, 7, and 14. These recommendations do not alter ACIP's guidance for the use of human rabies immune globulin, to be given on day 0. The recommendation was based on evidence from rabies virus pathogenesis data, experimental animal work, clinical studies, and epidemiologic surveillance. A 5-dose vaccine series is still recommended for those with altered immunocompetence.

The full ACIP report is found at the following web site: **http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5902a1.htm**. In the report, Table 3 outlines the rabies PEP schedule for both those not previously and those previously vaccinated.

Rise in Cryptosporidiosis in Idaho

In 2007, a large increase in the number of reported cryptosporidiosis cases was due in part to outbreaks associated with recreational water venues. In 2008, case reporting declined to background levels. In 2009, the number of reported cases remained low, but was higher than the average for the preceding three non-outbreak years (Figure), raising concern about the potential for an outbreak in summer 2010. Among cases reported during 2006–2009 where information was complete, 46% were in children aged <12 years. Hospitalization was required in 26% of patients aged 50 years and older and 8% of all patients. The mean time from onset of illness to diagnosis was 12 days. Cryptosporidiosis should be considered when patients present with watery diarrhea and can be misdiagnosed as viral gastroenteritis in children presenting with vomiting and fever. Routine ova and parasite tests do not always detect the oocysts: *Cryptosporidium*-specific tests are available. See **http://www.rwi.dhw.idaho.gov**.

Figure. Reported cryptosporidiosis cases by month of diagnosis*—Idaho, 2005–2009.



* 17 (2%) of 752 reported cases excluded due to missing diagnosis date.

† Y-axis is log scale

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