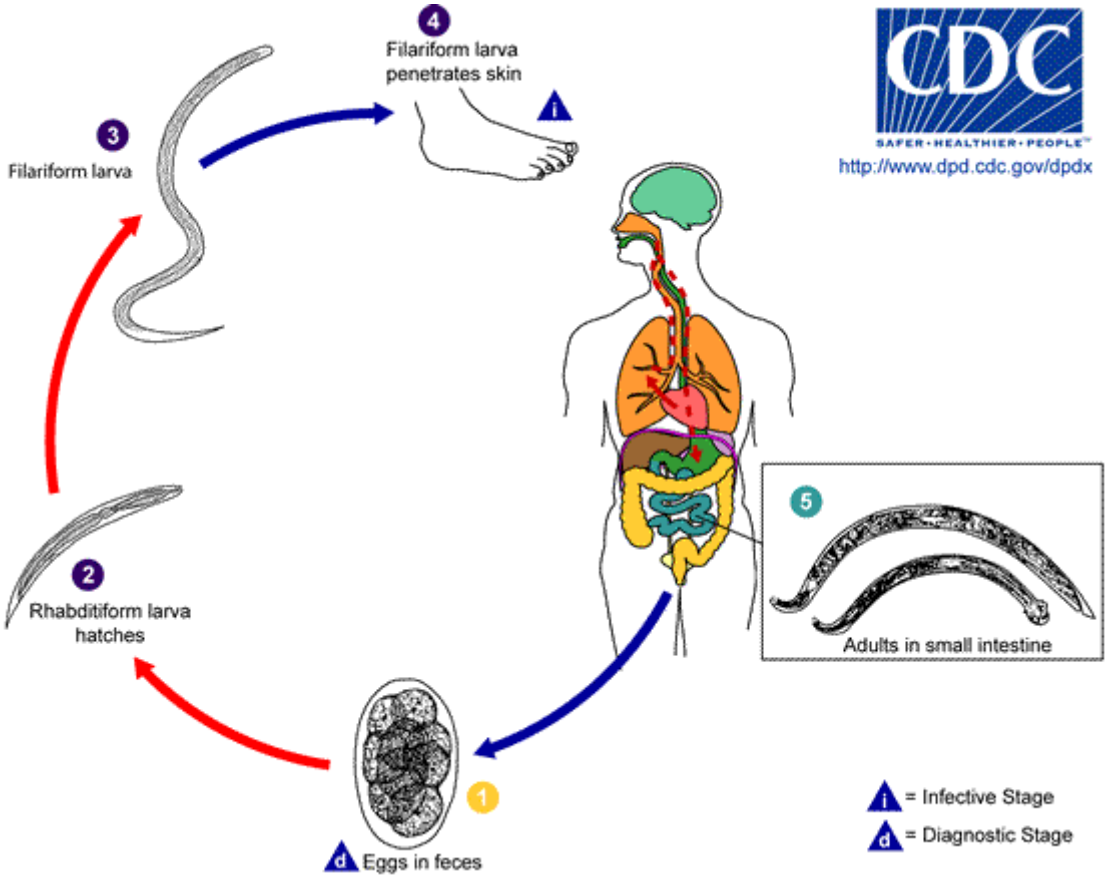
Hookworm

Causal Agents:

The human hookworms include two nematode (roundworm) species, *Ancylostoma duodenale* and *Necator americanus*. (Adult females: 10 to 13 mm (*A. duodenale*), 9 to 11 mm (*N. americanus*); adult males: 8 to 11 mm (*A. duodenale*), 7 to 9 mm (*N. americanus*). A smaller group of hookworms infecting animals can invade and parasitize humans (*A. ceylanicum*) or can penetrate the human skin (causing cutaneous larva migrans), but do not develop any further (*A. braziliense*, *A. caninum*, *Uncinaria stenocephala*). Occasionally *A. caninum* larva may migrate to the human intestine causing eosinophilic enteritis; this may happen when larva is ingested rather than through skin invasion.

Life Cycle:



Eggs are passed in the stool 1, and under favorable conditions (moisture, warmth, shade), larvae hatch in 1 to 2 days. The released rhabditiform larvae grow in the feces and/or the soil 2, and after 5 to 10 days (and two molts) they become filariform (third-stage) larvae that are infective 3. These infective larvae can survive 3 to 4 weeks in favorable environmental conditions. On contact with the human host, the larvae penetrate the skin and are carried through the veins to the heart and then to the lungs. They penetrate into the pulmonary alveoli, ascend the bronchial tree

to the pharynx, and are swallowed 4. The larvae reach the small intestine, where they reside and mature into adults. Adult worms live in the lumen of the small intestine, where they attach to the intestinal wall with resultant blood loss by the host 5. Most adult worms are eliminated in 1 to 2 years, but longevity records can reach several years. Some *A. duodenale* larvae, following penetration of the host skin, can become dormant (in the intestine or muscle). In addition, infection by *A. duodenale* may probably also occur by the oral and transmammary route. *N. americanus*, however, requires a transpulmonary migration phase.

Geographic Distribution:

The second most common human helminthic infection (after ascariasis). Worldwide distribution, mostly in areas with moist, warm climate. Both *N. americanus* and *A. duodenale* are found in Africa, Asia and the Americas. *Necator americanus* predominates in the Americas and Australia, while only *A. duodenale* is found in the Middle East, North Africa and southern Europe.

Clinical Features:

Iron deficiency anemia (caused by blood loss at the site of intestinal attachment of the adult worms) is the most common symptom of hookworm infection, and can be accompanied by cardiac complications. Gastrointestinal and nutritional/metabolic symptoms can also occur. In addition, local skin manifestations ("ground itch") can occur during penetration by the filariform (L3) larvae, and respiratory symptoms can be observed during pulmonary migration of the larvae.

Laboratory Diagnosis:

Microscopic identification of eggs in the stool is the most common method for diagnosing hookworm infection. The recommended procedure is as follows:

1. Collect a stool specimen.
2. Fix the specimen in 10% formalin.
3. Concentrate using the formalin–ethyl acetate sedimentation technique.
4. Examine a wet mount of the sediment.

Where concentration procedures are not available, a direct wet mount examination of the specimen is adequate for detecting moderate to heavy infections. For quantitative assessments of infection, various methods such as the Kato-Katz can be used.

Diagnostic Findings

- Microscopy
- Morphologic comparison with other intestinal parasites

Examination of the eggs cannot distinguish between *N. americanus* and *A. duodenale*. Larvae can be used to differentiate between *N. americanus* and *A. duodenale*, by rearing filariform larvae in a fecal smear on a moist filter paper strip for 5 to 7 days (Harada-Mori). Occasionally, it may be necessary to distinguish between the rhabditiform larvae (L2) of hookworms and those of *Strongyloides stercoralis*.

Treatment:

In countries where hookworm is common and reinfection is likely, light infections are often not treated. In the United States, hookworm infections are generally treated with albendazole*. Mebendazole* or pyrantel pamoate* can also be used.

* This drug is approved by the FDA, but considered investigational for this purpose.