Nematodes, continued

***Ancylostoma duodenale* (intestinal hookworm)**

These nematodes are called intestinal hookworms, and they are known for their voracious blood feeding habits. Two principal species infect around 900 million person a year. *Necator americanus* is known as the new world hookworm and Ancylostoma duodenale is known as the old-world hookworm.

Morphology

Adult worm

* **Appearance** S-shaped worm with pinkish-white color
* **Size**: female is 10-13 mm in length by 0.6 mm in diameter while males are 8-11 mm by 0.4 mm
* **Shape**: the posterior end has an umbrella shaped bursa with rib-like rays and two pairs of curved teeth on the ventral wall of its buccal capsule





Egg

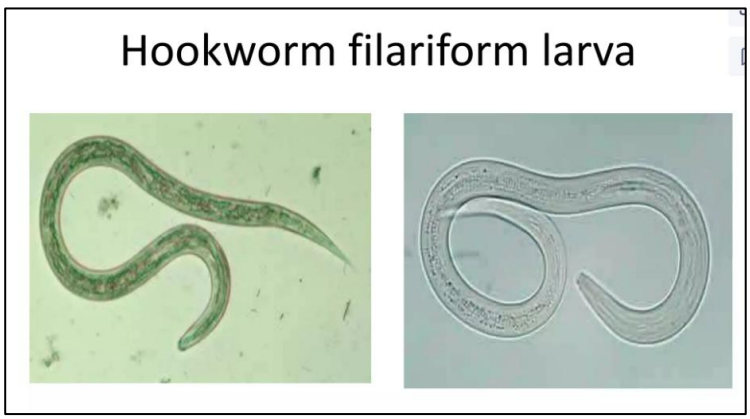
- females laying from 10,000 to 30,000 eggs per day
- eggs are oval or elliptical, measuring 60 by 40 µm, colorless, and with a thin transparent hyaline shell membrane.
- Each egg contains a few cells grouped together "morula"
- the eggs with single ovum develop in the intestine, then passed in feces having a segmented ovum with 4 to 8 blastomeres.



Larva

Eggs → hatch in the environment into larva L1 → L2 → L3 ready to penetrate human skin
The hatched **rhabditiform** (non-infective) larvae grow in the feces or soil for 5 to 10 days and mature into **filariform** (infective) larvae



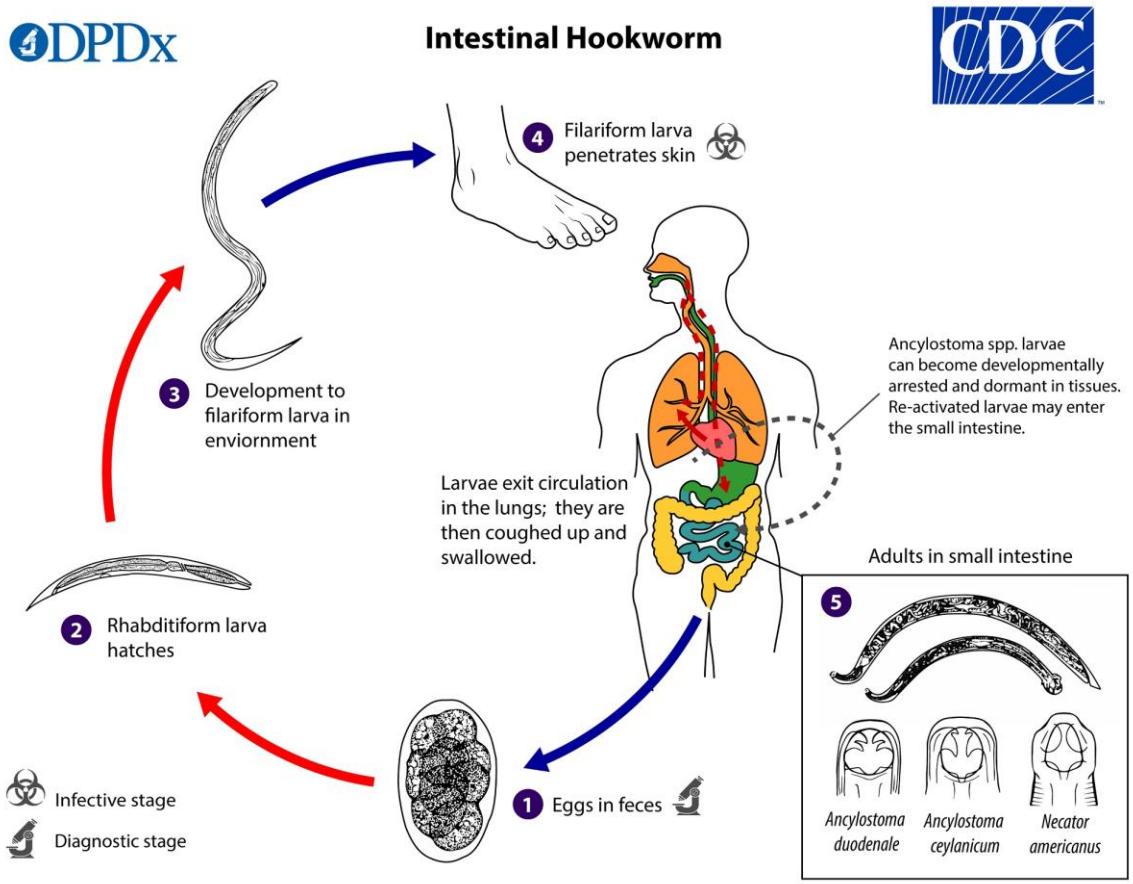


Life cycle

- **Mode of transmission:** Penetration of the skin by larvae when they come in contact with the skin between the toes, the dorsum of the feet and the inner side of the soles. Another method of infection when drinking water contaminated with L3 larva.
- **Host:** it infects only humans as the final hosts, no intermediate host is required.
- **Infective stage:** Larvae stage 3

Five stages of life cycle:

1. **Passage of eggs from the infected host:** The eggs containing segmented ova with four blastomeres are passed out in the feces of the infected human host.
2. **Development in the soil:** From each egg a 250 um rhabditiform larva hatches out in the environment in about 48 hours. This larva molts twice in the 3rd and 5th day to later develop into a 500-600 um filariform larva which is the infective stage of this worm.
3. **Entrance into a new host:** the filariform larvae are infective and they enter the human body by penetrating the skin.
4. **Migration:** As the filariform larva penetrates the skin and enter the lymphatics or small venules. It is then carried out to the heart and lungs where they break the capillaries and enter the alveoli. Then they migrate on to the bronchi, trachea and larynx and ultimately swallowed. A terminal buccal capsule is formed during a third molt in the esophagus.
5. **Localization and laying eggs:** The larva settles down in the small intestine and it attaches to the intestinal mucosa by the buccal capsule. After a month they sexually mature and start laying fertilized eggs which will be passed in the feces to start a new cycle.



Pathogenesis and Clinical Feature



1. The worm causes hookworm disease or ancylostomiasis.
2. The larvae cause lesions on the skin at the site of penetration called Ancylostoma dermatitis (ground itch) and creeping eruption where the larva remain wandering in the skin for weeks and up to 2 years.
3. Lesions in the lung such as bronchitis and bronchopneumonia when the larva breaks the pulmonary capillaries.
4. Anemia of microcytic hypochromic type occurs due to the blood sucking of the adult worm for nutrition.

Laboratory Diagnosis

1. Examination of stool for detection of eggs.
2. Detection of larva in the sputum
3. Occult blood test is positive indicating intestinal bleeding
4. Blood test shows elevated levels of eosinophil.

Treatment:

Albendazole 400 mg once and supplements for treating anemia such as ferrous sulphate (iron) and folic acid with vitamin B12.

Enterobius vermicularis

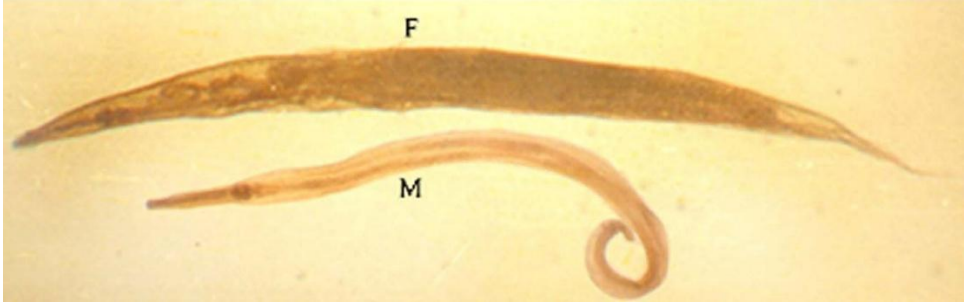
Enterobius vermicularis, the human pinworm or thread worm, formerly known as *Oxyuris vermicularis* has been known from ancient times. The name means a tiny worm living in the intestines (Greek *enteron*-intestine *bios*-life and *vermiculus*-small worm). The female worm has a sharp tail from which the name pinworm was derived.

Morphology

Adult worm

*** Appearance**

These worms have a round body with cylindrical ends and a complete digestive system including mouth and anus. They have separate sexes where the female is usually larger than the male. Right after mating, the male usually dies, therefore it is rarely seen.

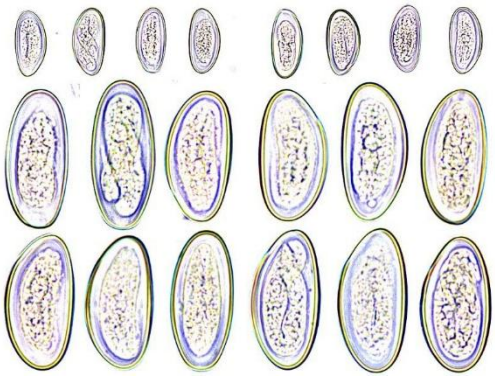


* **Size**: female: ~ 8-13 mm long, Male: small (2-5 mm).

* **Shape**: creamy white round female with sharply pointed tails; Wing-like flaps (cervical alae) at head end while male is smaller with strongly curved posterior.

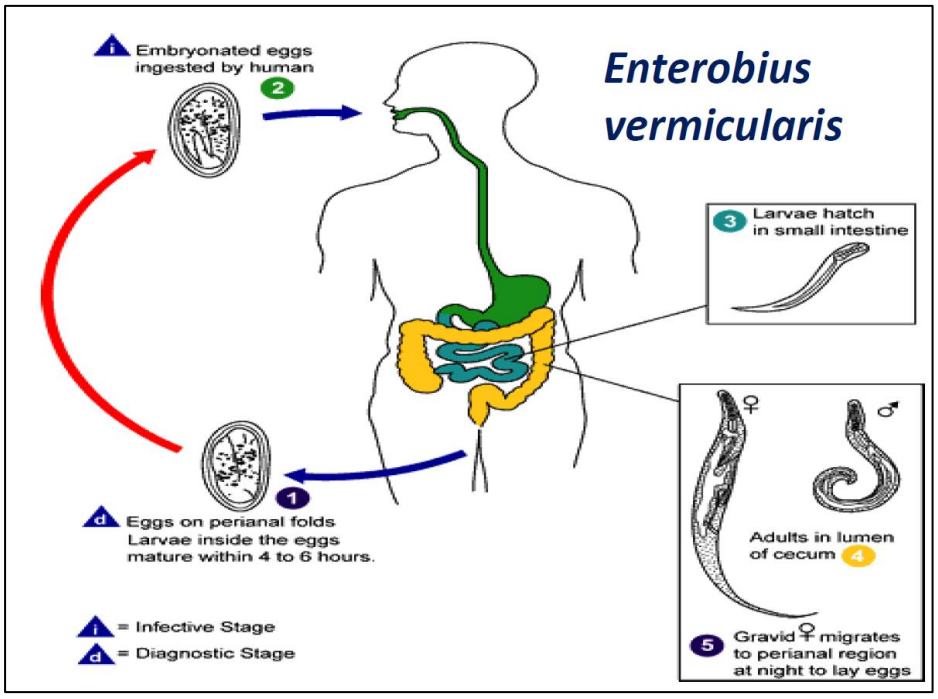
Egg

Eggs are small colorless D shaped with dimensions of 50-60 * 20-30 um. They contain a single cell (immature egg) or larvae (mature egg)



Life cycle

Mode of transmission: ingestion of embryonated eggs with contaminated food or by contaminated hand through fecal-oral route.
Host: human is the only definitive host, no intermediate host is required.
Infective stage: embryonated eggs



Pathogenesis and Clinical Feature

Enterobiasis is frequently asymptomatic. The most typical symptom is perianal pruritus, especially at night, which may lead to excoriations and bacterial superinfection

Laboratory Diagnosis

Microscopic identification of eggs collected in the perianal area by cellophane (Graham Scotch) tape method or anal swabs. This must be done in the morning, before defecation and washing

Treatment:

Anthelmintics, such as mebendazole and albendazole