Intestinal helminths
Ascaris lumbricoides (Roundworm)

- egg ingested, hatches in duodenum
- larvae penetrate intestine wall, enter blood vessels and embolize through liver to lungs
- they then migrate into airspaces, up trachea and are swallowed
- taking up permanent adult residence in the small intestine
- ~2 months from egg to mature adult
Ascaris lumbricoides (Roundworm)

- About 650 million infected worldwide mainly tropics.
- Transmission is faecal-oral; egg very resistant, can survive years.

**Clinical**
- related to number of worms; small numbers asymptomatic
- large numbers of adults in intestine -- obstruction, pains
- cause malnutrition if in large numbers

**Diagnosis:** stool examination for eggs

**Treatment:** mebendizole, albendazole

Adults from one child

Eggs in stool sample
**Trichuris trichiura** (Whipworm)

- life cycle: people infected by swallowing embryonated egg, hatches in small intestine, attaches to colonic epithelium and matures to egg laying in 3 months.
Trichuris trichiura (Whipworm)

- restricted to warm climate by necessity for egg to embryonate on moist warm soil for 10-14 days before becoming infective
- spread: fecal - oral (esp. via foods and hands)

**Clinical**
- clinical: 99% asymptomatic
- heavy load gives diarrhea, dysentery, anemia, rectal prolapse

**Diagnosis**
- examine stool (standard techniques) - pathognomonic egg

**Treatment**
- mebendizole, albendizole


**Enterobius vermicularis** (Pinworm)

- Infected by swallowing egg which hatches after contact with stomach acid and matures to adult which then resides in lumen of caecum (from egg to adult maturation in 15-43 days)
- Female migrates onto perianal skin to lay eggs at night (adult female approx. 10 mm long)
**Enterobius vermicularis** (Pinworm)

- **Spread**: fecal - oral; eggs can survive days to weeks in environment

**Clinical**
- Most asymptomatic
- <10% anal pruritus; rarely vaginitis

**Diagnosis**
- Less than 10% found in stools, i.e. not a useful examination;
- Best is pinworm swab - cellophane tape swab, or sticky paddle

**Treatment**
- Mebendazole, albendazole, pyrantel pamoate
**Ancylostoma duodenale** and **Necator americanus** (Hookworms)

- Eggs in feces hatch and mature as larvae in warm moist soil.
- Develops into infective (filariform) larvae in 7 days.
- Filariform larvae penetrate skin of host (e.g. bare feet), circulate to lungs where they penetrate alveoli, move up bronchi and are swallowed.
- Then, as adults, they attach by mouth to small intestinal mucosa and suck blood.
- Prepatent period (time from skin penetration to egg production) is 4-5 weeks.
- Adults can live 5-15 years.
Ancylostoma duodenale and Necator americanus (Hookworms)

- transmission by contact of skin with soil contaminated with larvae

Clinical

usually asymptomatic 90%
heavy infections (20 – 100 worms)
iron deficiency anemia
malnutrition from protein loss
rarely itch at skin entry site

Diagnosis: Stool examination for ova

Treatment: mebendizole, albendazole
**Strongyloides stercoralis**

- The only important helminth that can complete its life cycle in the human host and hence increase its numbers.
- Special problem in immunocompromized because of this.
- Mainly a tropical parasite because requires warm moist soil for transmission.

**Transmission**: skin contact with invasive larvae in soil.
**Strongyloides stercoralis – life cycle**

- Larvae passed into soil in human feces where mature in several days to skin invasive (filariform) larvae.
- Can exist for months in soil "free living" by completing life cycle without contact with human host man.
- Larvae penetrate skin, move via blood vessels to lung, invade airspace, move up bronchi, are swallowed, and then penetrate small intestinal mucosa where they mature to adults in submucosa.
- They deposit eggs in submucosa and these hatch and migrate into intestinal lumen.
- Internal autoinfective cycle – rhabditiform larvae → filariform larvae inside patient
**Strongyloides stercoralis** – clinical manifestations

- most asymptomatic
- peptic ulcer like symptoms, diarrhea rarely
- cutaneous larvae currens (trunkal itchy dermatitis)
- hyperinfection (disseminated strongyloides) in immunocompromised spread of larvae to peritoneum, lung, CNS with contamination of those organs with gram negative bacteria
- transmural small intestine spread of larvae and bacteria with necrosis of intestine
Strongyloides stercoralis – diagnosis

- stool examination (difficult to find strongyloides)
- duodenal aspirate or Enterotest duodenal string test
- serology (the most sensitive)
- culture of stool (Harada-Mori or Baerman) allows "free living" strongyloides to multiply
- agar plate tracking
A Baermann apparatus as used to isolate *Strongyloides stercoralis* stages from coprocultures.

- **F**, 150mm glass or plastic funnel
- **W**, tap water at 43°C
- **FL** (dashed line) fluid level in funnel
- **SB**, Sample basket shown to right in exploded view (**FCC**, fecal charcoal culture contents)
- **KW**, two layers of Kimwipes or other laboratory tissue
- **LRM** Lucite ring with nylon mesh affixed with cement
- **T**, rubber or plastic tubing
- **PC**, pinch clamp
- **CV**, catch vessels, conical centrifuge tube, or beaker.
Taenia solium or T. saginata (Taeniasis)

- The tapeworm larval cyst (cysticercus) is ingested with poorly cooked infected meat.
- The larva escapes the cyst as it traverses the small intestine where it attaches to the mucosa by the scolex suckers.
- The proglottids develop as the worm matures in 3-4 months.
- The adult may live in the small intestine of a patient as long as 25 years and pass gravid proglottids with feces.
- Eggs extruded from the proglottid contaminate the vegetation where they persist and remain infective for several days.
• *T. saginata* is 6-10 meters long and 12 mm broad. It has a pear-shaped (head) scolex with four suckers but no hooks, a neck, and long flat body with several hundred segments (proglottids), 18 x 6 mm each with branched uterus (15-30 branches).
Taenia solium

- *T. solium* is slightly smaller than *T. saginata*. It has a globular scolex with four suckers and a circular row of hooks (rostellum) that gives it a solar appearance, neck and long flat body (4-5 meter) consisting of proglottids (5 x 10 mm) with 7-12 branched uterus.
The eggs of *T. saginata* and *T. solium* are morphologically indistinguishable:

- roundish (35 x 45 μ) yellow-brown eggs that have peripheral radial striations and contains an embryo with 3 hooklets
• Light infections remain asymptomatic, but heavier infections may produce abdominal discomfort, epigastric pain, vomiting and diarrhea.
Diagnosis is based on the recovery of eggs or proglottids in stool or from the perianal area.
Diphyllobothrium latum (fish tapeworm)

- It is the longest tapeworm of man, ranging from 3-10 meters with more than 3000 proglottids.
- The scolex resembles two almond-shaped leaves.
- The proglottids are more broad than long, a morphology reflected by the tape’s name.
- Eggs are 30x50 μ in size and contain an embryo with 3 pairs of hooklets.
**Diphyllobothrium latum – life cycle**

- Man and other animals are infected by eating uncooked fish that contains plerocercoid larvae (15x2 mm) which attach to small intestinal wall and mature into adult worms in 3-5 weeks.
- Eggs discharged from gravid proglottids in the small intestine are passed in the feces.
- The egg hatches in fresh water to produce a ciliated coracidium that, for its survival needs to be ingested by a water flea (Cyclops) where it develops into a plerocercoid larva.
- When infected Cyclops is ingested by the freshwater fish, the procercoid larva penetrates the intestinal wall and develops into pleocercoid larva, infectious to man.
Diphyllobothriosis – symptoms

- Clinical symptoms of diphyllobothriosis may be mild to severe, depending on the number of worms. They include abdominal discomfort, loss of weight, loss of appetite and some malnutrition. Anemia and neurological problems associated with vitamin B\textsuperscript{12} deficiency are seen in heavily infected individuals.
**Diphyllobothrium latum – diagnosis**

- Diagnosis is based on finding many typical eggs and empty proglottids in feces.
- A history of raw fish consumption and residence in an endemic locality is helpful.

**Treatment and control**
- Praziquantel is the drug of choice.
- Freezing for 24 hours, thorough cooking or pickling of fish kills the larvae.

*Figure 1 - A: adult worm. B: typical rosette-shaped uterus. C: histological section showing: 1. cirrus sac, 2. ovaries, 3. vitellaria, 4. seminal sac. D: egg showing: a. operculum, b. knob.*
**Hymenolepis nana** (Dwarf tapeworm)

1. Embryonated egg in feces
2. Egg ingested by insect
3. Humans and rodents are infected when they ingest cysticeroid-infected arthropods.
4. Embryonated egg ingested by humans from contaminated food, water, or hands
5. Oncosphere hatches, cysticeroid develops in intestinal villus
6. Scolex
7. Adult in ileal portion of small intestine
8. Eggs can be released through the genital atrium of the gravid proglottids. Gravid proglottids can also disintegrate releasing eggs that are passed in stools.
9. Autoinfection can occur if eggs remain in the intestine. The eggs then release the hexacanth embryo, which penetrates the intestinal villus continuing the cycle.

=i= Infective Stage

=d= Diagnostic Stage
**Hymenolepis nana**

- Light infections produce vague abdominal disturbances but heavier infections may cause enteritis.
- **Diagnosis** is based on finding eggs in the feces.
- Praziquantel is the drug of choice. Hygiene is the best control.

On the inner membrane are two poles, from which 4-8 polar filaments spread out between the two membranes. The oncosphere has six hooks.