Estimated Prevalence

Hookworms	740,000,000
Ascaris lumbricoides	1,472,000,000
Trichuris trichiura	1,049,000,000
Wuchereria bancrofti	107,000,000
Schistosomes (all)	200,000,000

Source: American Society For Parasitologists 2003

Morbidity and Mortality

Science, Vol 302, Issue 5652, 1921-1922 , 12 December 2003
[DOI: 10.1126/science.1092488]

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The Burden of Chronic Disease

C. G. Nicholas Mascie-Taylor[1*] and Enamul Karim[2]

Table 1. Estimated global prevalences and associated morbidity and mortality due to soil-transmitted helminths and schistosomes.

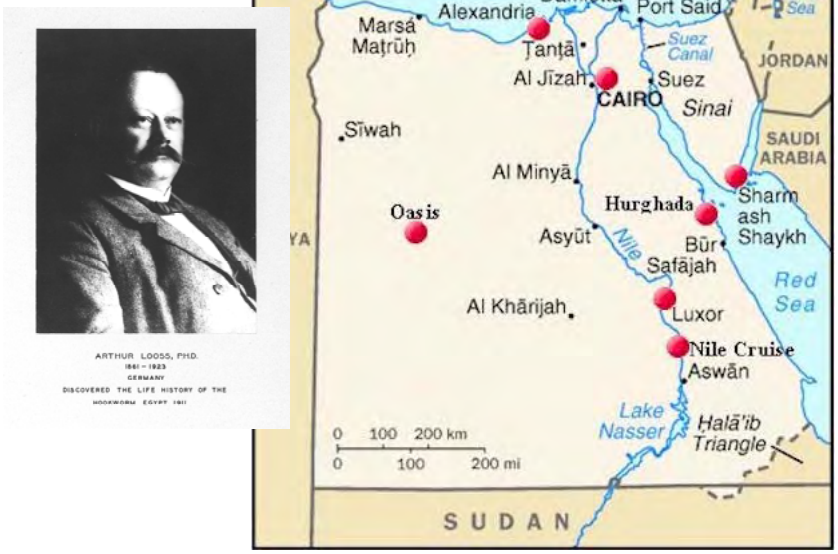
Parasite	Prevalence of infection (cases, millions)	Mortality (deaths, thousands)	Morbidity (cases, millions)
Ascaris lumbricoides	1450	60	350
Trichuris trichiura	1050	10	220
Hookworms	1300	65	150
Schistosomes	200	20	20

Helminths

Nematoda:

The Hookworms

Ancylostoma duodenale
Necator americanus



Antonie Dubini* and the Saint Gotthard Tunnel Hookworm Epidemic of 1880

Length - 15 kilometers
Depth - 1,700 meters

"An effort….. to build a rail tunnel through the St. Gotthard massif was treacherous. That construction between 1872 and 1882 was plagued by bad rock and flooding. It killed 310 workers, incapacitated 877 others and bankrupted the contractor".

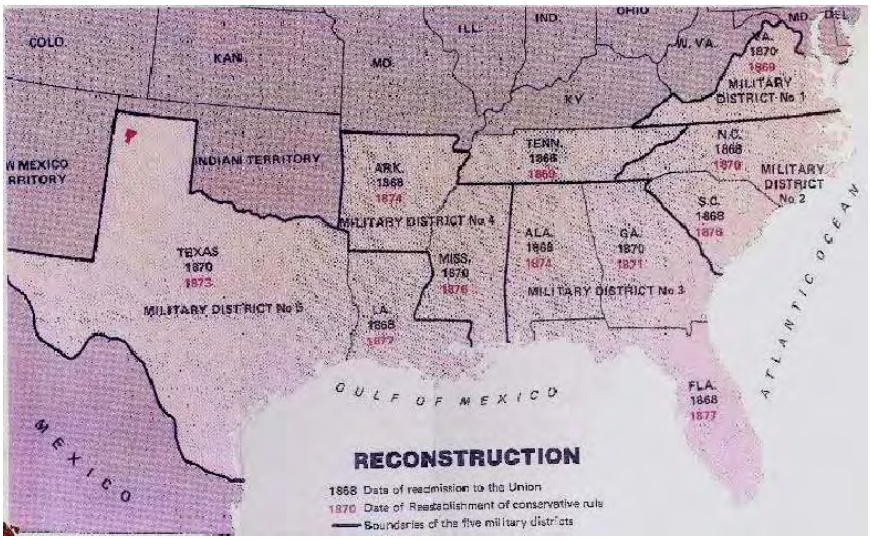
* Dubini, A. Ann. Univ. Med. Milano. 1843 106:5-13. First record of disease caused by hookworm

Distribution Of hookworm up to 1927

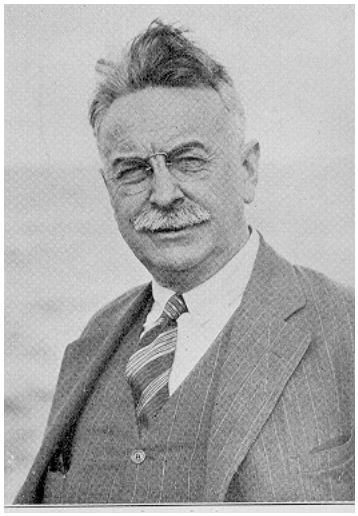
Coelho, Philip R. P. and Robert A. McGuire, "Biology, Diseases, and Economics: An Epidemiological History of Slavery in the American South," Journal of Bioeconomics 1:2 (1999):151-190.

One theory suggests that hookworm disease may have influenced the outcome of the civil war. Southern troops grew up with the infection and had little in the way of sturdy clothing or shoes. Hookworms were brought to America from Africa in the early 1800s via the slave trade. They have been here ever since.

Economic recovery was slow following the Civil War, and J. D. Rockefeller wanted to know why

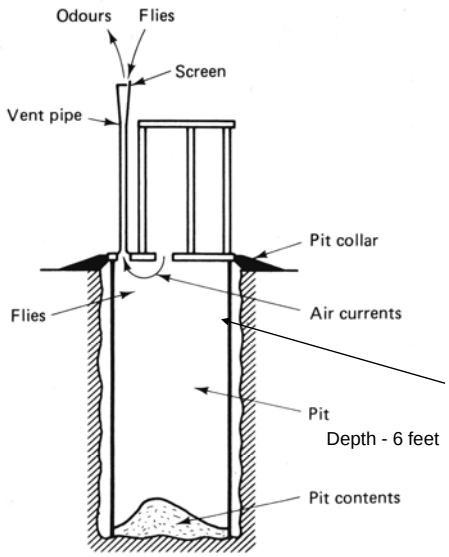


John D. Rockefeller



JDR established a sanitary commission (1909-1915) headed by Charles Wardell Stiles to look into the matter of “southern laziness”.

The Pit Privy



Distribution and installation began in the 1920's following The Rockefeller Sanitary Commission Report to Congre

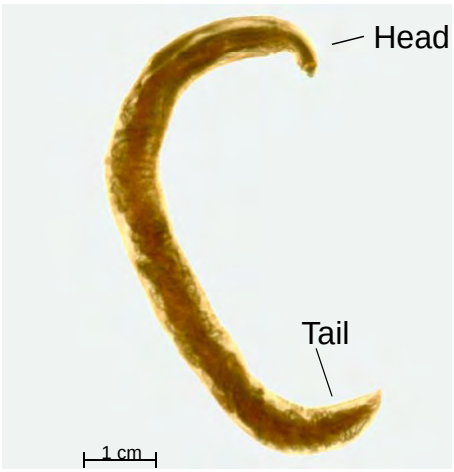
Height to which hookworm larvae can crawl = 4 feet.

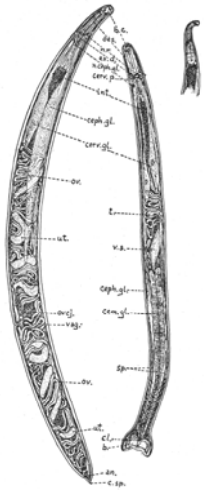
Colorado Out House*

* The camper's best friend

Circa 2006

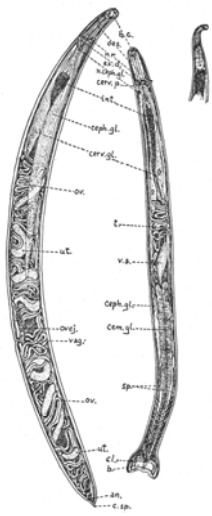
Adult female *Ancylostoma duodenale*

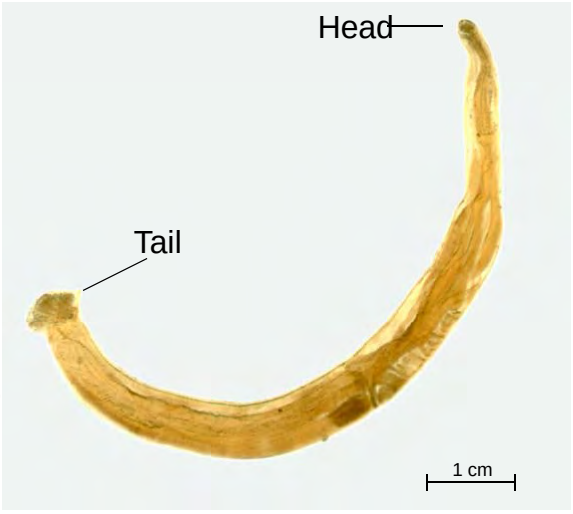




Looss' original elegant drawings

Adult male *Ancylostoma duodenale*

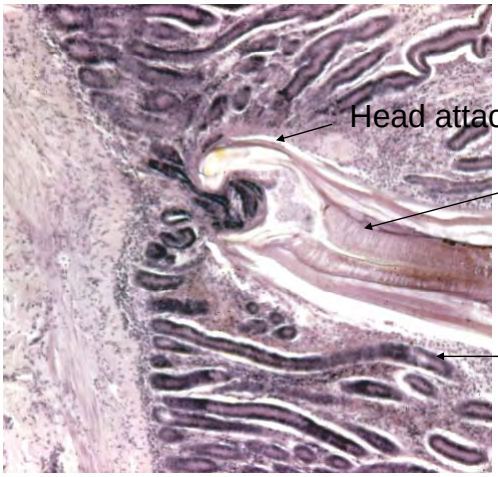




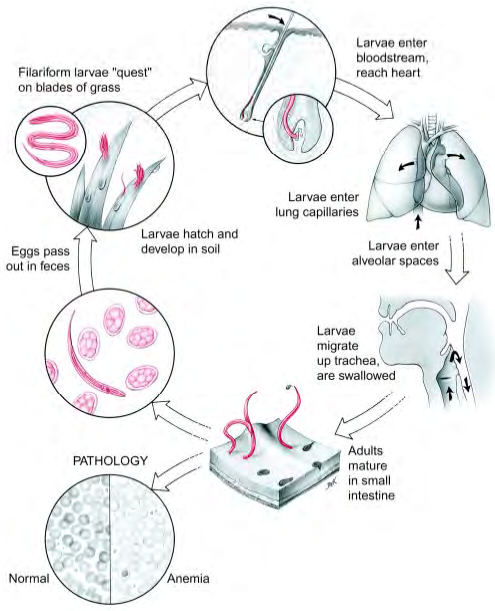
Adult *Ancylostoma duodenale*

Adult *Necator americanus*

Histological section of adult hookworm attached to villus of small intestine



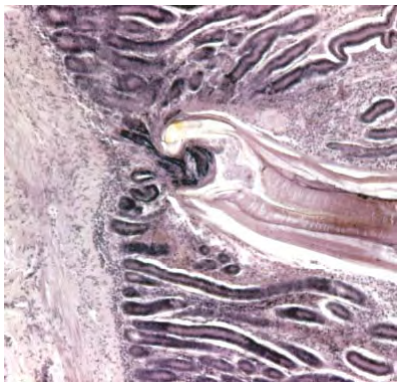
Necator americanus



Hookworm larvae in dog skin

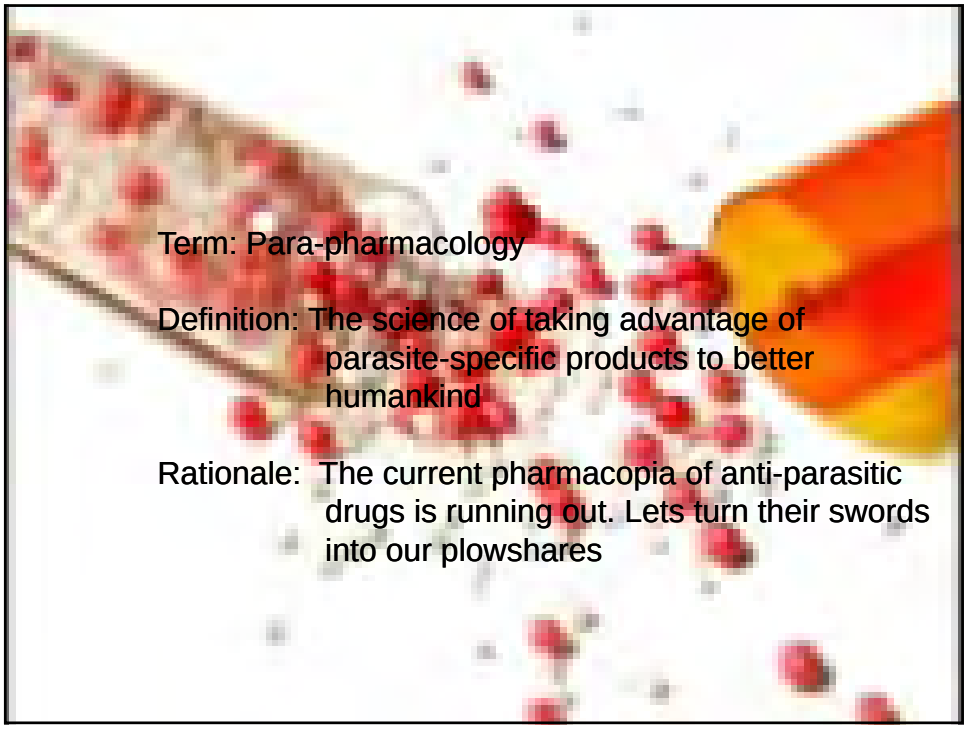
Pathogenesis:

Adult worms suck blood and feed on villus tissue.



In order to do all this, the worm has evolved a set of powerful anti-coagulants*even more effective than those of the medical leech. The cDNAs for these HW peptides have be cloned and may offer some interesting practical application for medical use.

* Cappello, M. et al. 1995. PNAS USA. 92: 6152-56



Term: Para-pharmacology

Definition: The science of taking advantage of parasite-specific products to better humankind

Rationale: The current pharmacopia of anti-parasitic drugs is running out. Lets turn their swords into our plowshares

Hookworm adult as seen on endoscopy

Clinical Disease:

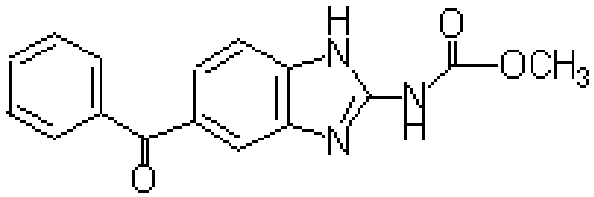
1. Iron-deficiency anemia

2. Failure-to-thrive syndrome
   (idiopathic endocrinopathy)

Diagnosis:

Microscopic examination of feces for eggs

Drug of choice:



Mebendazole

Mode of Action:
De-polymerizes invertebrate microtubules, only

Prevention and Control

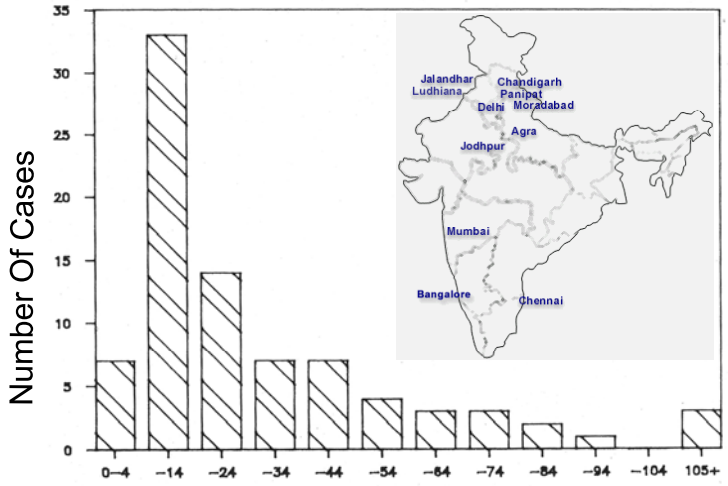
"*To prevent this (hookworm) it is only necessary to prevent soil pollution with the feces of infested individuals*"

……..***Hookworm Disease***

Asa Chandler, 1929

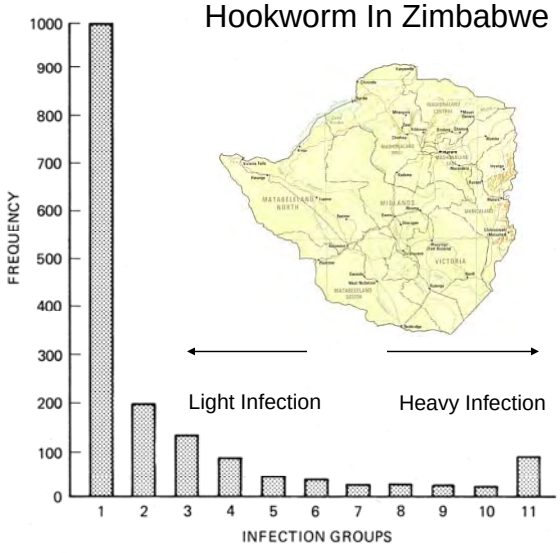
Greatest single invention of the 20th century

Ancylostoma In India



Number Of Worms Per Person

Hookworm In Zimbabwe



Dogs and *Ancylostoma caninum*

Paro, Bhutan

Infectious larva of *Ancylostoma sp.*

"Creeping eruption" on the foot of a patient
who stepped on an infective larva of *A. braziliense*

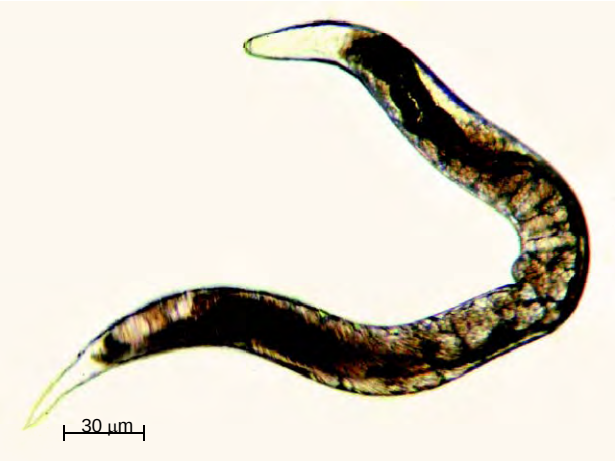
Photo: G. Zalar

Helminths

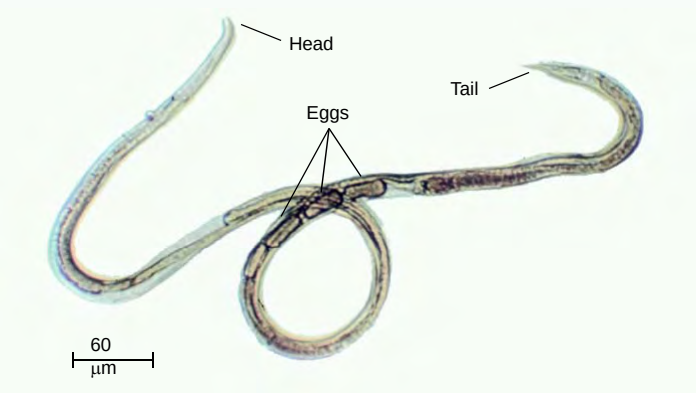
Nematoda:

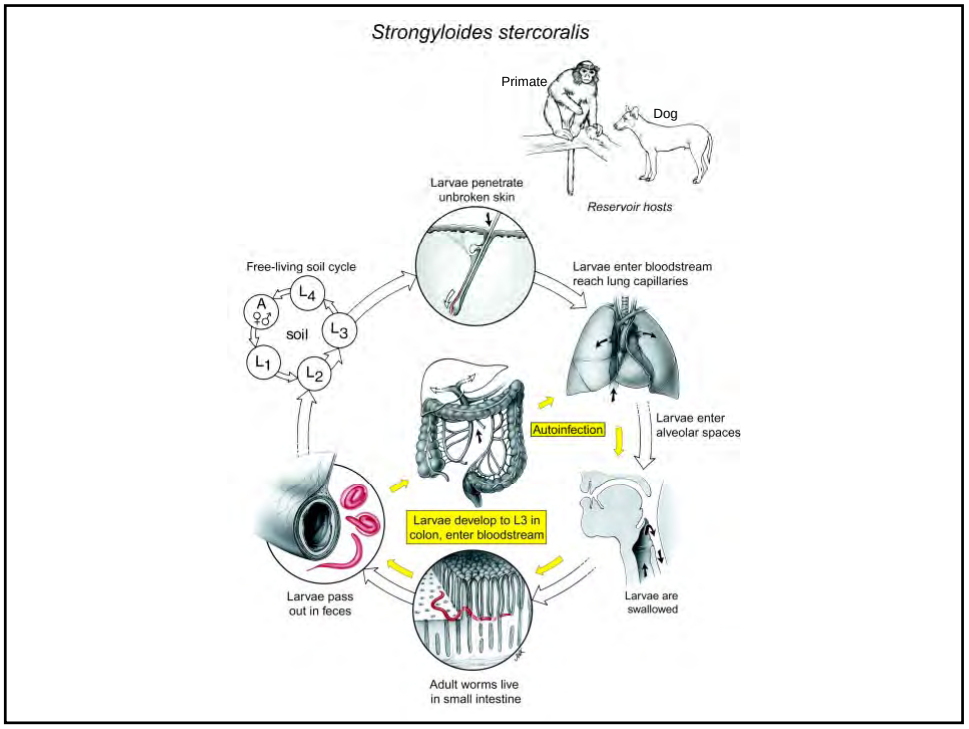
Strongyloides stercoralis

Free-living female *Strongyloides stercoralis*

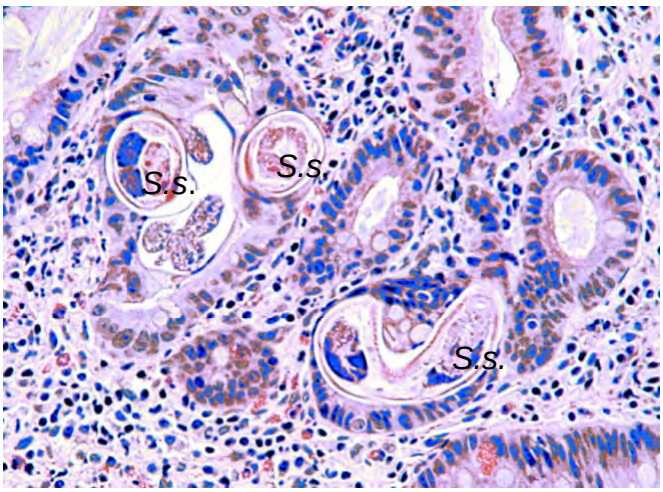


Parasitic female *Strongyloides stercoralis*

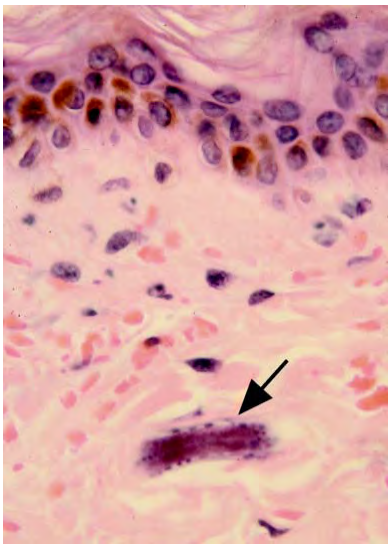




Strongyloides stercoralis in situ



Larva of *Strongyloides stercoralis* in skin



Pathogenesis:

Worms invade epithelial cells, induce cell death

Clinical Disease:

1. Diarrhea

2. Malabsorption syndrome

3. Secondary bacteremia/septicemia as larvae migrate throughout body and defecate microbes that they ingested in large intestine.

4. Death due to overwhelming bacterial septicemia.

Diagnosis:

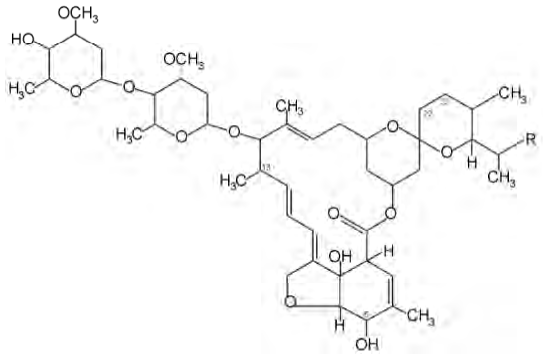
1. Microscopic examination of feces (x 6)

2. “String” test

Second stage larva

Drug of choice:

Ivermectin*



Mode of Action:

Blocks $Cl^{(-)}$ ion channels, inhibits γ-aminobutyric acid receptor complex.

* Alternate drug for all geohelminths

Prevention and Control:

Sanitary disposal of human feces*

*Dog is a common reservoir host. Cannot control spread of dog feces which may contain infective larvae.