

Enterobius vermicularis and Enterobius gregorii

- Enterobiasis (pinworm infection)
- Intestinal nematode: biology, pathology, diagnosis and prevention
- Clinical and laboratory correlations

Dr Abu Suraih Sakhri

MBBS, MD (Pathology)

www.abusuraihsakhri.com

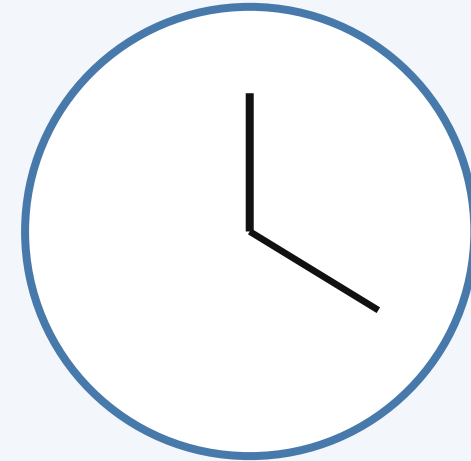
Learning outcomes

- Explain transmission and the luminal life cycle
- Recognize adult and egg morphology
- Link nocturnal oviposition to pruritus
- Select the correct diagnostic specimen
- Interpret the *E. Gregorii* taxonomy caveat

A characteristic clinical presentation

- Child with nighttime perianal itching
- Household members may have similar complaints
- A targeted morning specimen is more informative than routine stool testing

Clock time matters diagnostically



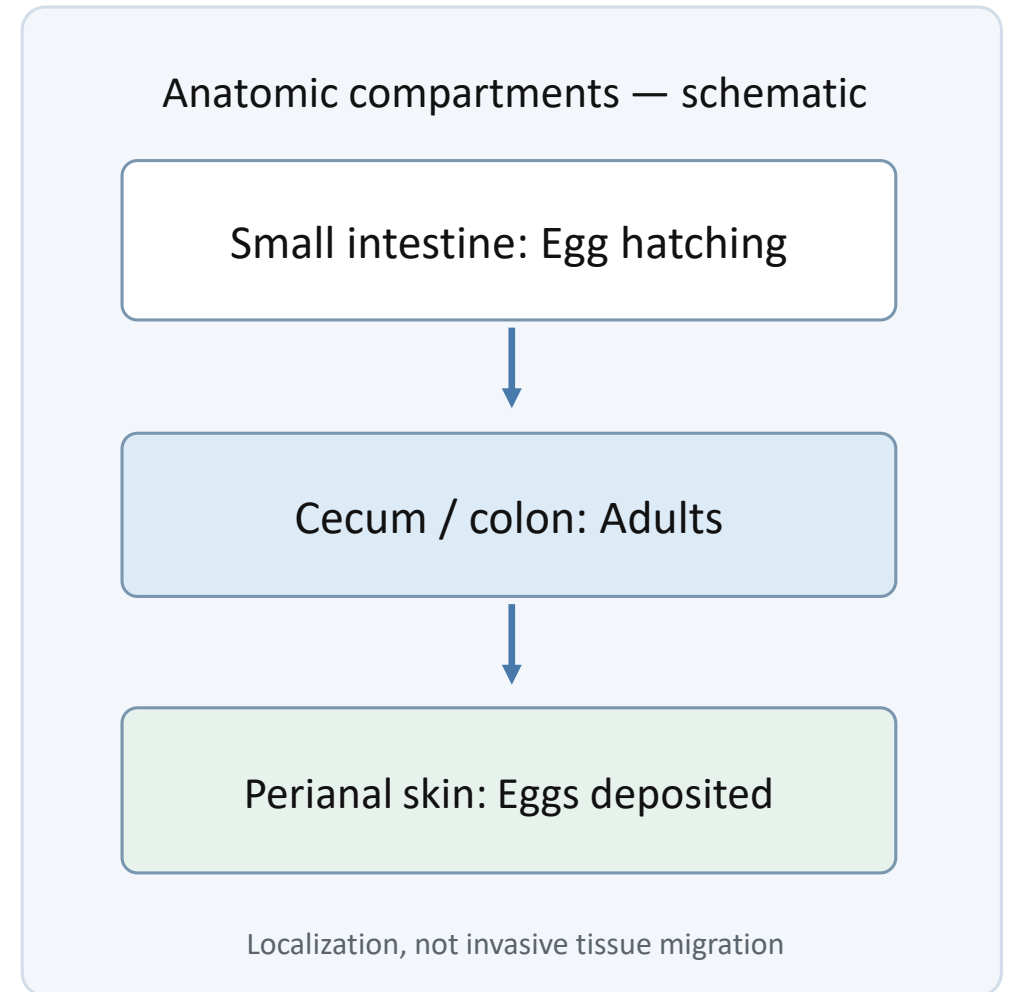
Night

Female migration and egg laying

Early-morning tape test: Before washing

Enterobiasis: Core definition

- Infection with human pinworms, classically *E. Vermicularis*
- Adults usually inhabit the cecum and adjacent colon
- Symptoms result mainly from egg deposition outside the anus



Where pinworms fit among helminths

- Pinworms are nematodes (roundworms)
- Unlike invasive larval nematodes, their usual cycle is intestinal and perianal
- Diagnostic specimen choice follows the parasite life cycle

ENTEROBIUS

Fecal–oral eggs • Perianal egg collection • Pruritus dominant

ASCARIS

Fecal–oral eggs • Stool ova • Tissue migration

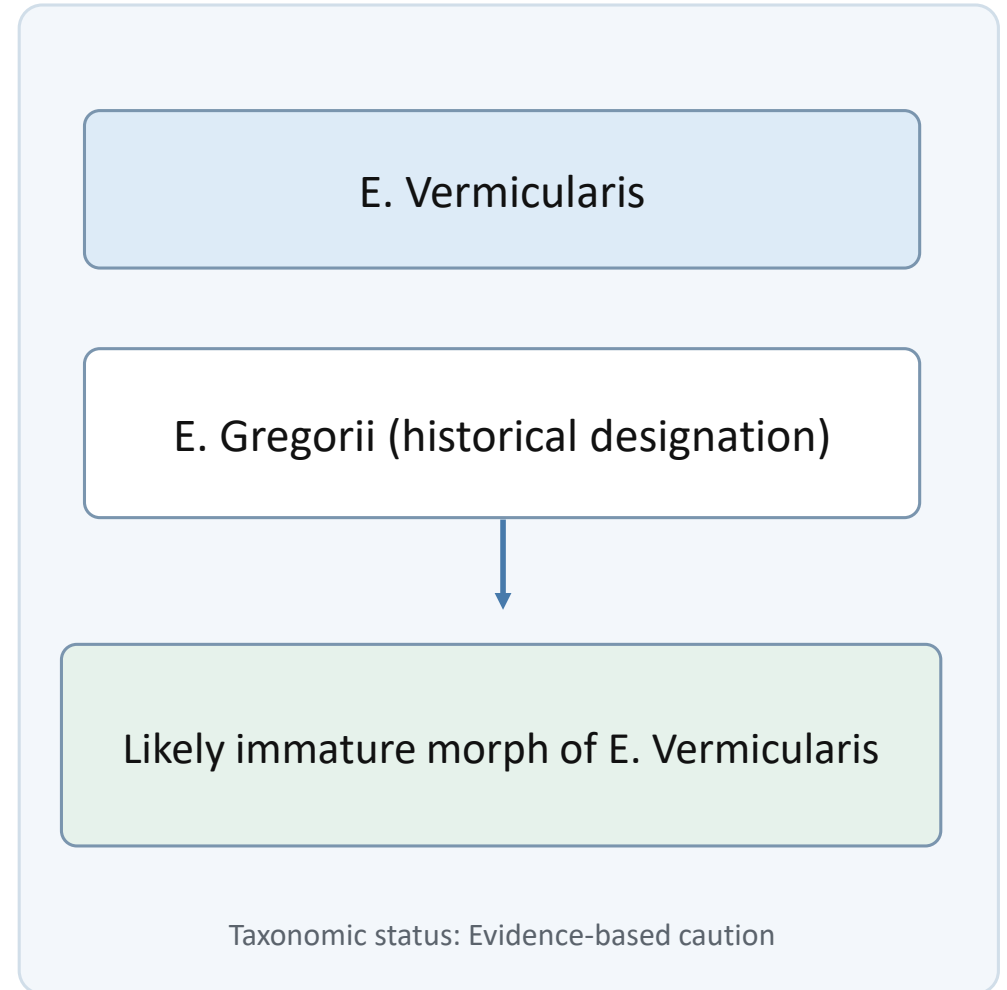
STRONGYLOIDES

Skin-penetrating larvae • Stool larvae • Autoinfection possible

Differential comparison, not equivalent disease burdens

The two names are not equivalent certainty

- *E. Vermicularis* and *E. Gregorii*
- *E. Vermicularis* is the established principal human pinworm
- *E. Gregorii* remains a historical/putative species designation



Historical basis of *E. Gregorii*

- Originally proposed as a separate human pinworm species
- Male spicule morphology was the key distinguishing feature
- Taxonomic separation was morphology-based, not a distinct clinical syndrome

E. Vermicularis

E. Gregorii (historical designation)



Likely immature morph of *E. Vermicularis*

Taxonomic status: Evidence-based caution

Later morphology challenges species separation

- 1998 study examined a series of male pinworms
- Intermediate spicule forms were observed during maturation
- Authors interpreted the gregorii-like form as a younger stage

E. Vermicularis

E. Gregorii (historical designation)

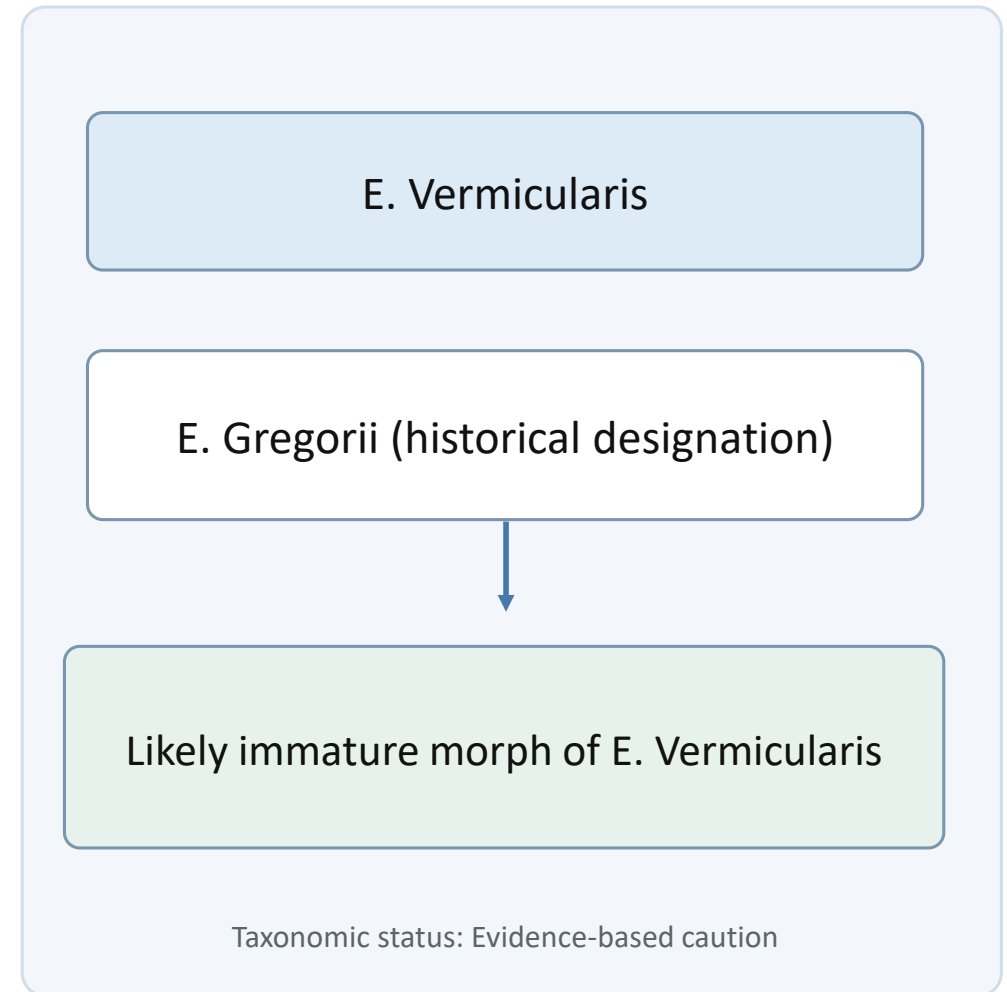


Likely immature morph of E. Vermicularis

Taxonomic status: Evidence-based caution

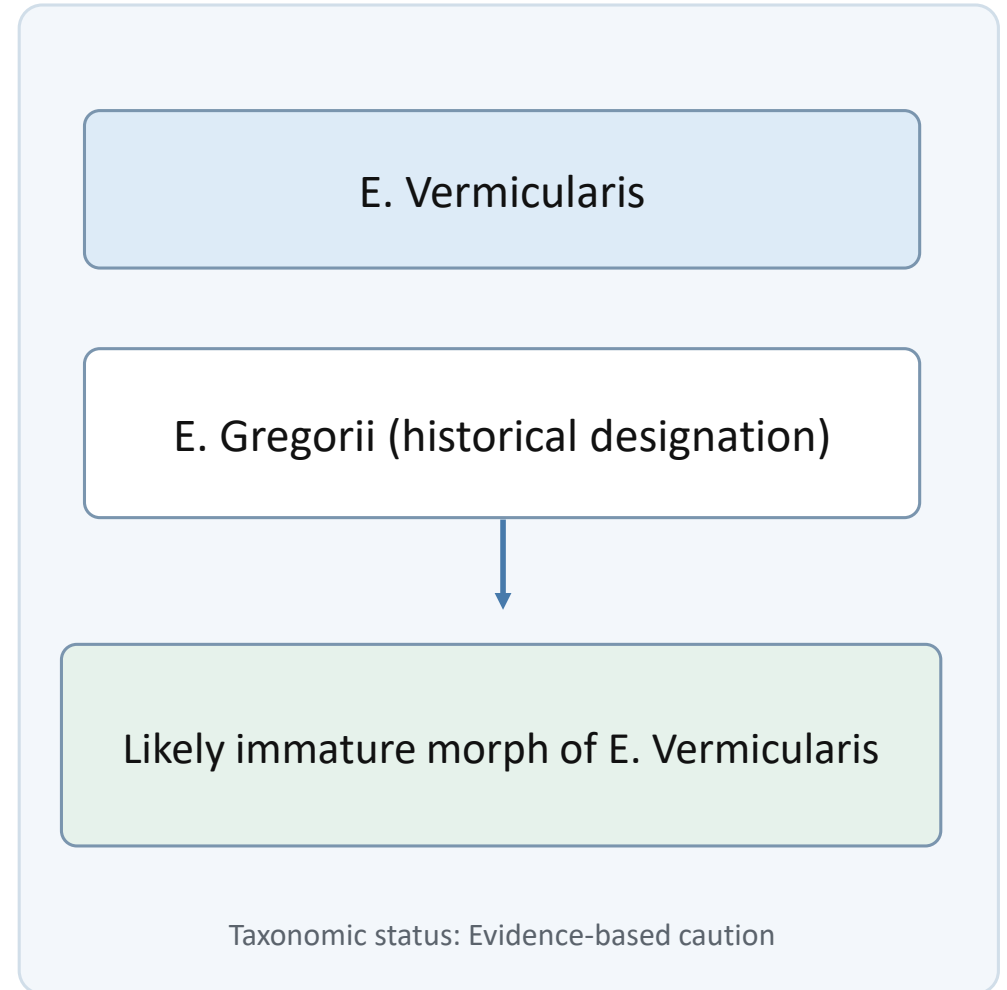
Molecular evidence also favors synonymy

- Sequence-based work found evidence supporting synonymy
- CDC DPDx describes *E. Gregorii* as a putative species
- Avoid teaching two definitively distinct pathogens without qualification



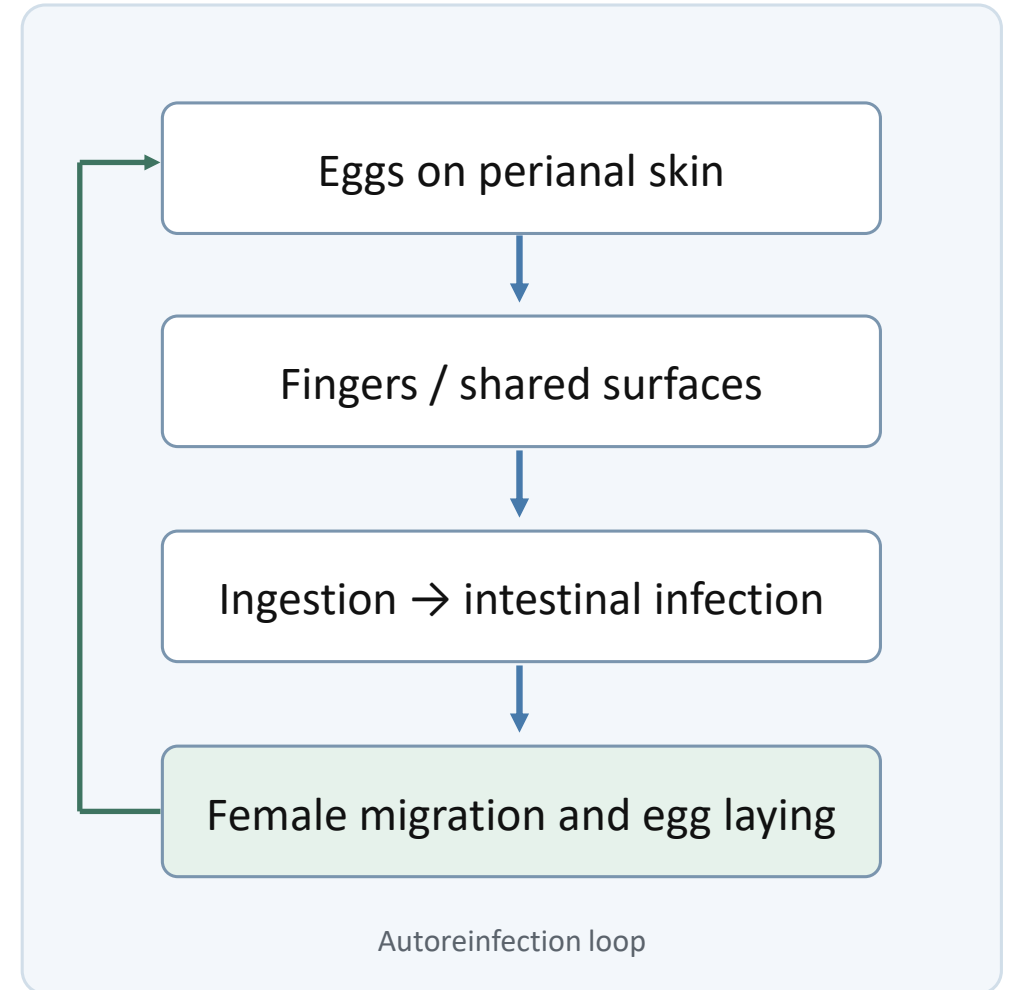
Practical consequence of the nomenclature

- Teach the shared enterobiasis syndrome
- Do not infer different diagnosis or treatment solely from the historical name
- Record molecular/taxonomic interpretation separately wording



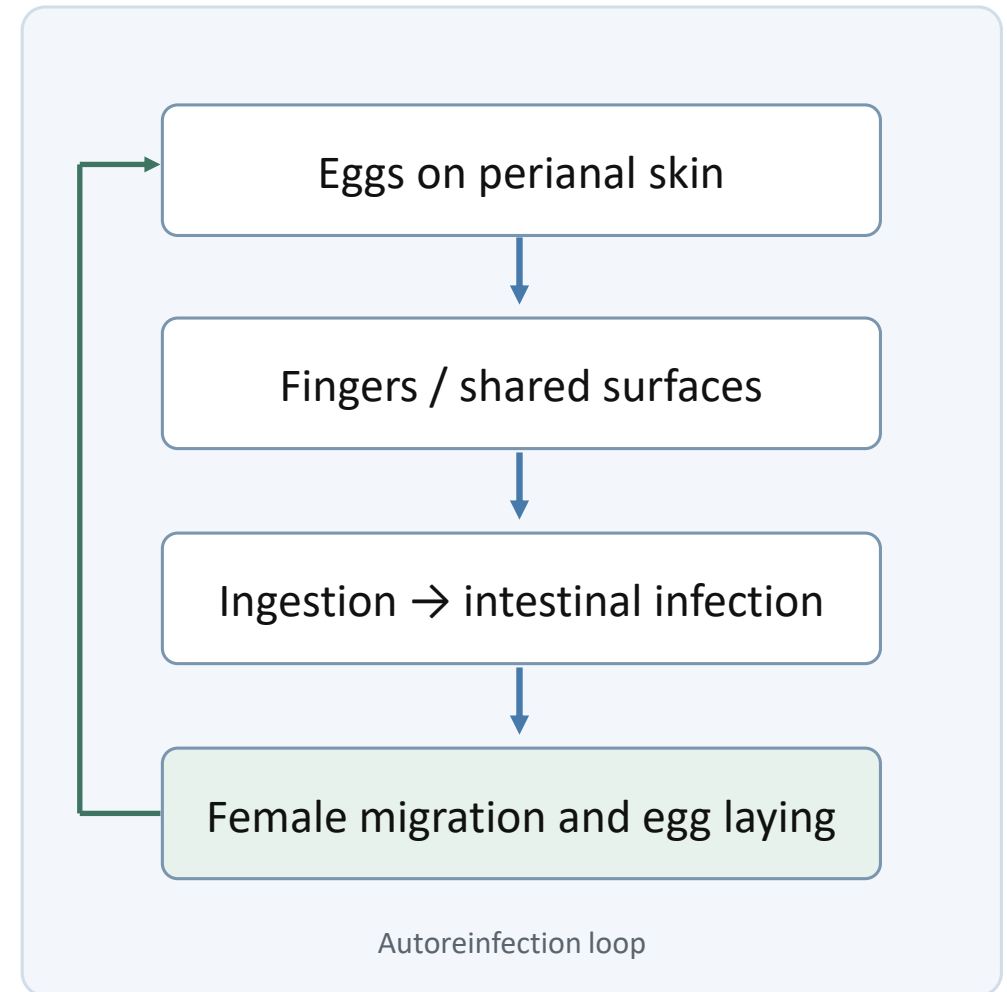
Enterobiasis occurs worldwide

- Occurrence in high- and low-resource settings
- CDC identifies preschool and school-aged children as common groups
- Household and institutional transmission sustain infection



Why access to resources does not eliminate risk

- Transmission requires microscopic eggs, not tropical vectors
- Shared living spaces and direct contact facilitate spread
- Repeated exposure can overcome treatment without household control



Groups with greater exposure

- Preschool and school-aged children
- Household members, caregivers and close contacts
- Crowded or institutional living settings

Hands and short clean nails

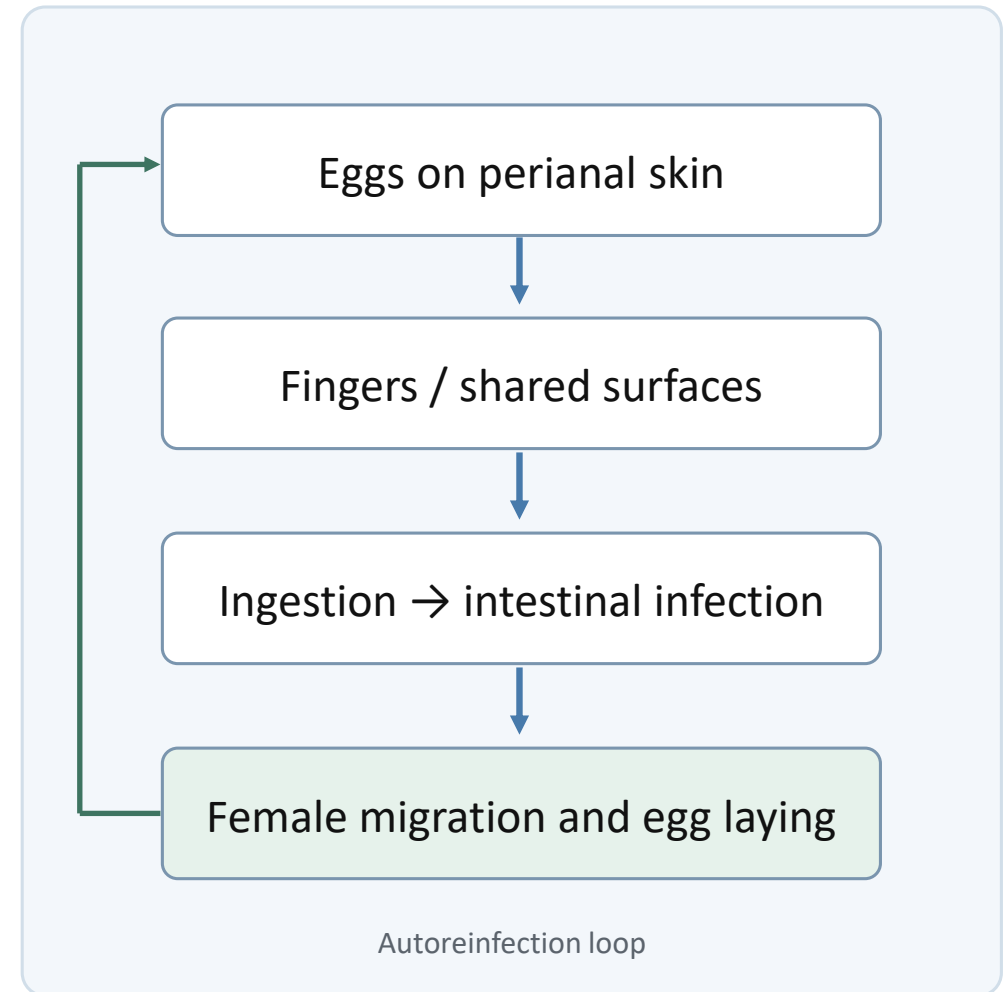
Morning bathing + clean clothing

Bedding and laundry hygiene

Simultaneous household management

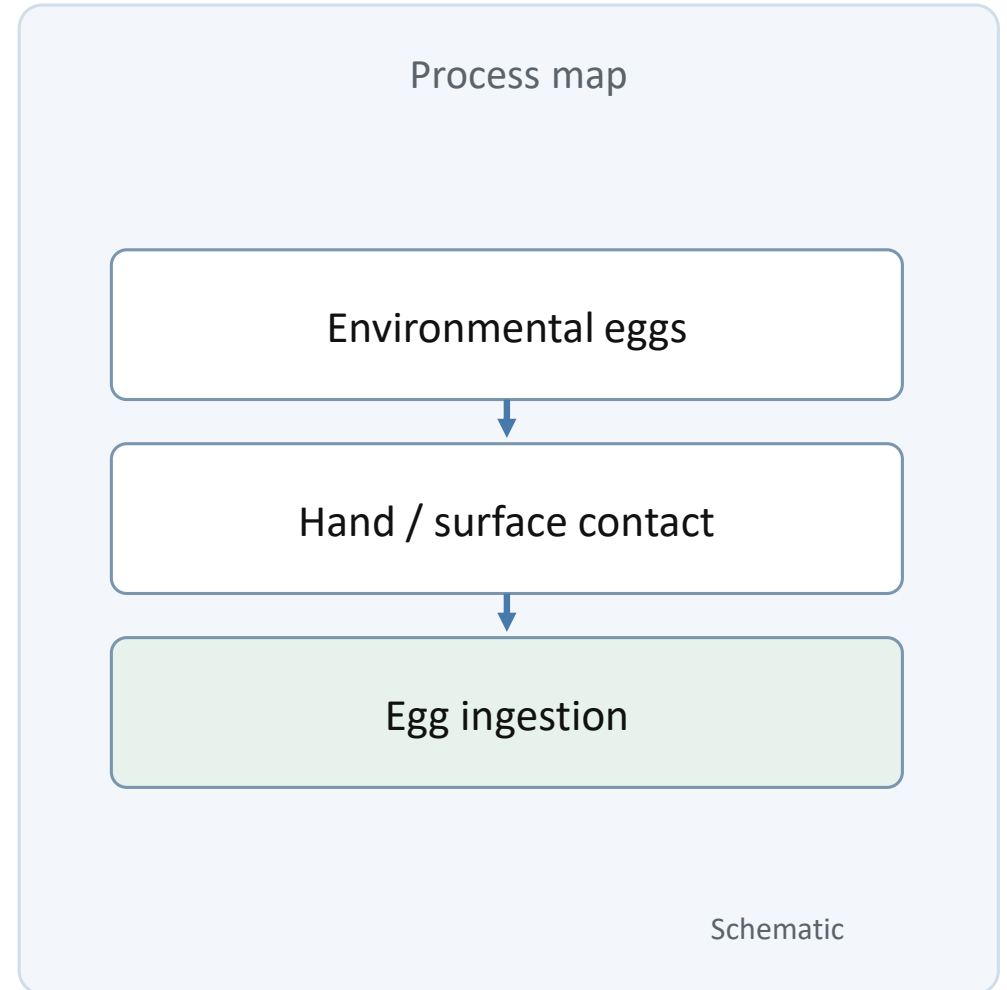
Host specificity and reservoir

- Humans are the usual host for *E. Vermicularis*
- A human-to-human cycle explains household clustering
- Routine household transmission is not driven by pet reservoirs



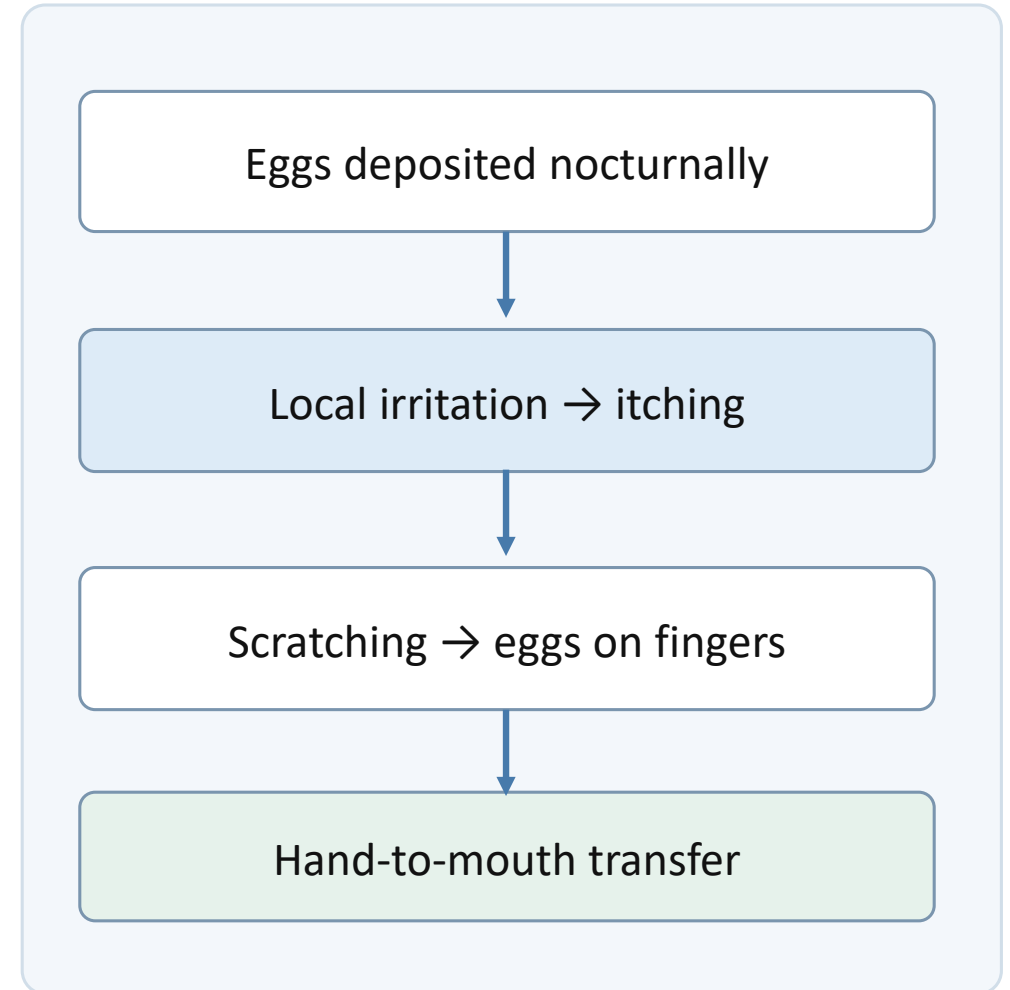
Infection begins with ingestion of eggs

- Infective eggs reach the mouth from contaminated hands
- Fomites such as clothing, bedding and surfaces can carry eggs
- Infection is acquired without a skin-penetrating larval stage



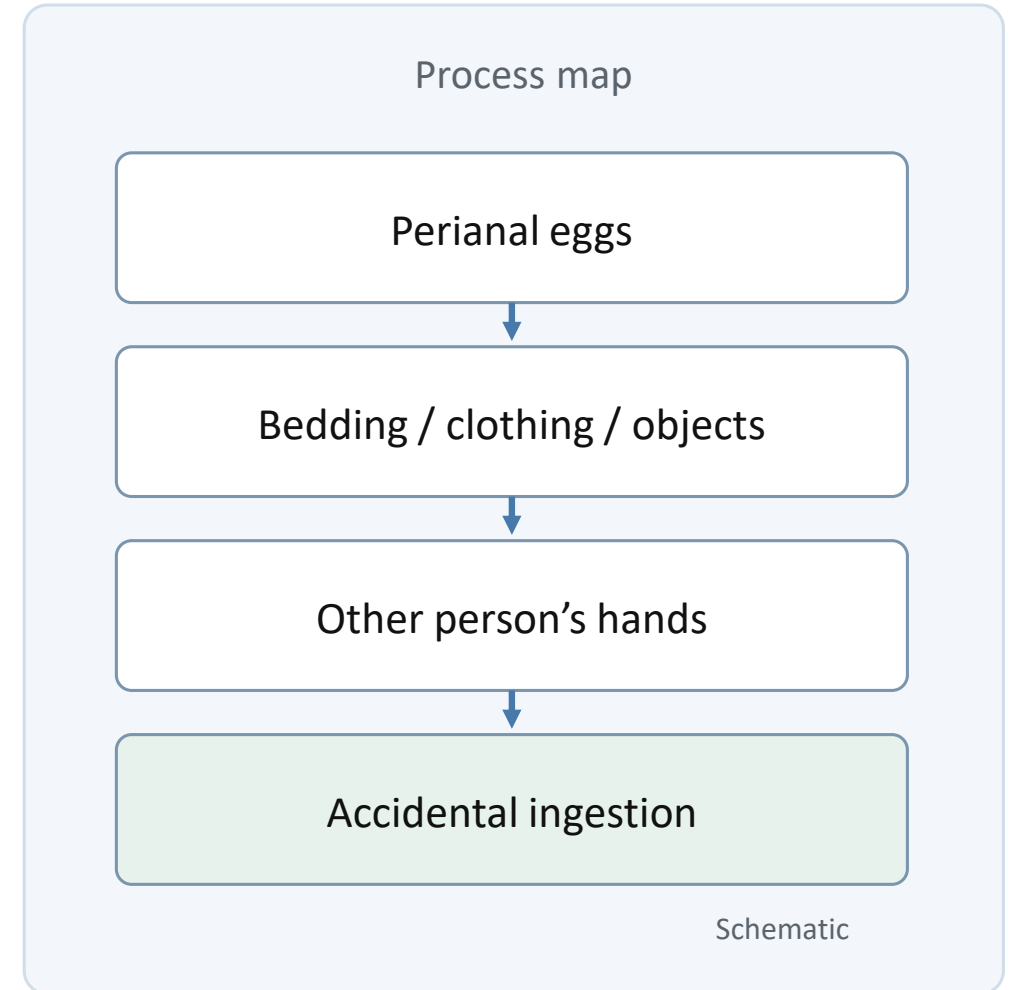
Direct autoinoculation: Hand-to-mouth

- Eggs deposited near the anus cause itching
- Scratching transfers eggs to fingers and beneath nails
- Subsequent oral contact can establish another infection



Environmental transmission: Shared objects

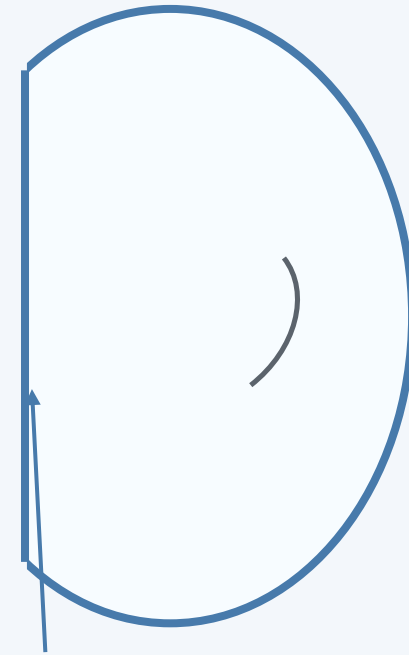
- Adhesive eggs contaminate fabrics and household objects
- Close contact can transfer microscopic eggs to another person
- Cleaning and hand hygiene interrupt a non-vector cycle



Egg infectivity develops rapidly

- Eggs embryonate on the perianal skin
- CDC DPDx: Infective development in about 4–6 hours under optimal conditions
- Time-dependent infectivity helps explain efficient person-to-person spread

Asymmetric pinworm egg

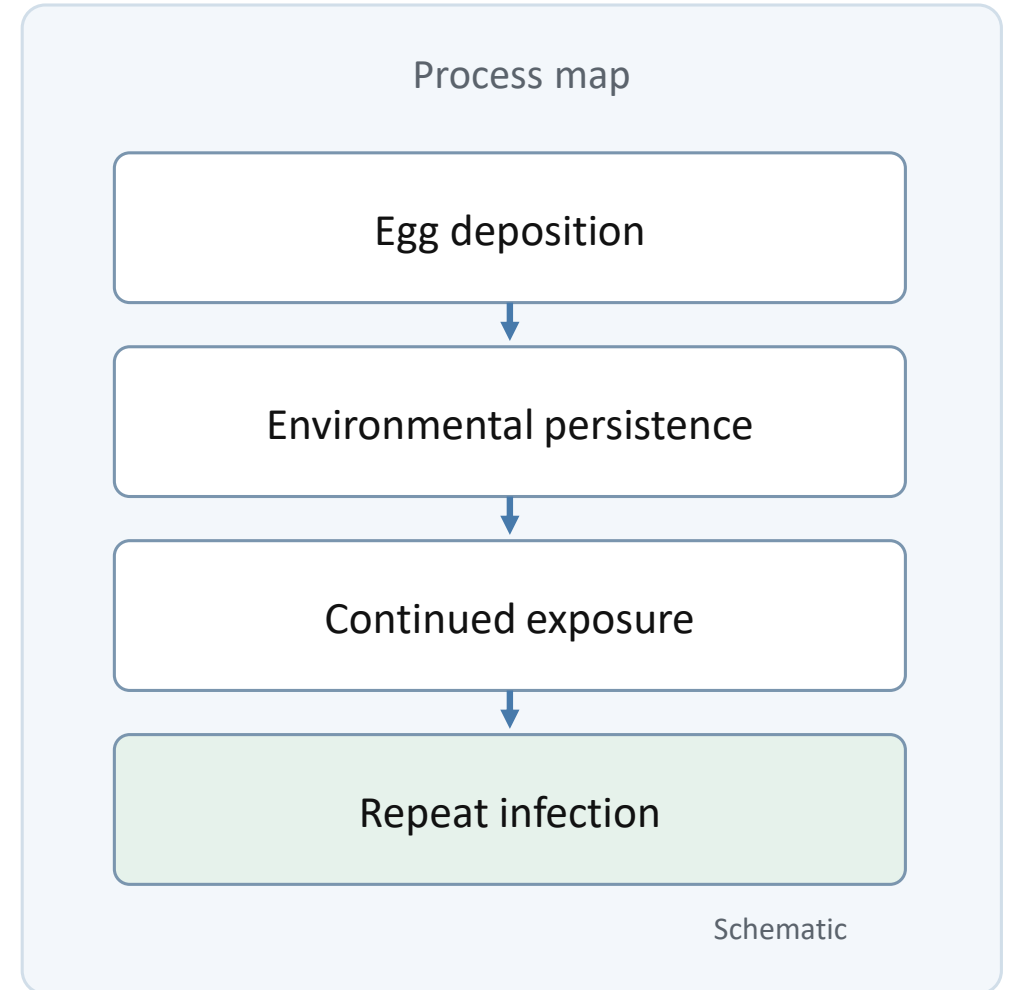


Flattened side

Schematic — not microscopy

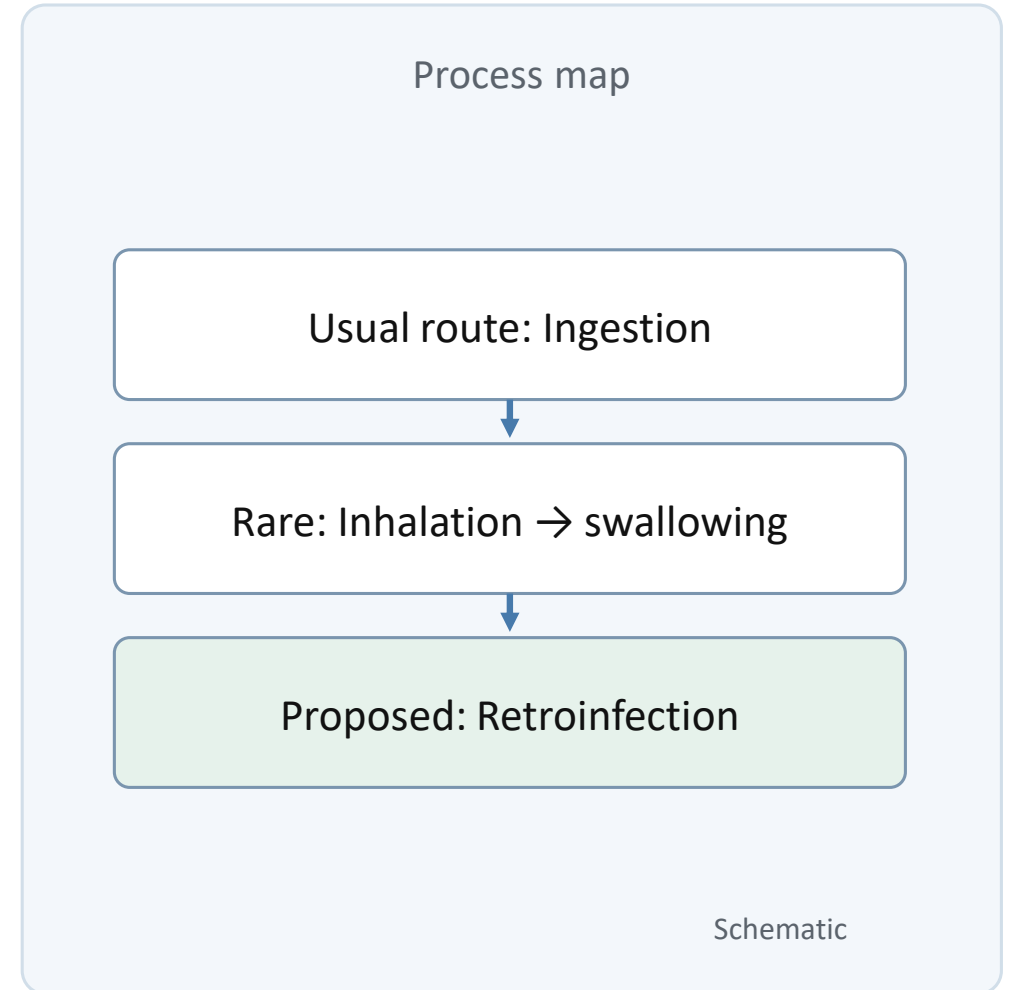
Environmental survival promotes recurrence

- CDC reports egg survival on objects for 2–3 weeks if not cleaned
- Viable environmental eggs can outlast a single treatment event
- Survival should not be confused with adult worm life span



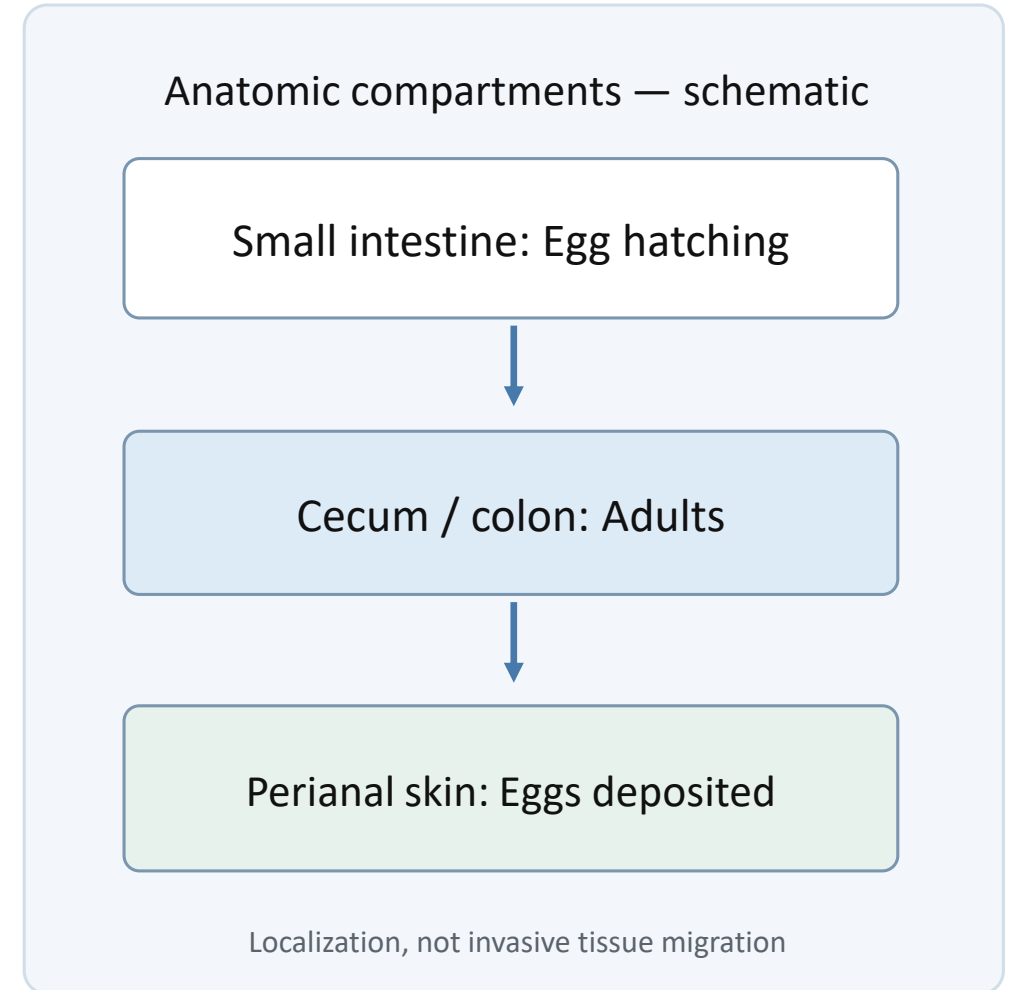
Rare exposure and retroinfection pathways

- Airborne eggs may rarely be inhaled and swallowed
- Retroinfection has been described as larvae moving from perianal skin to rectum
- CDC DPDx states the frequency of retroinfection is unknown



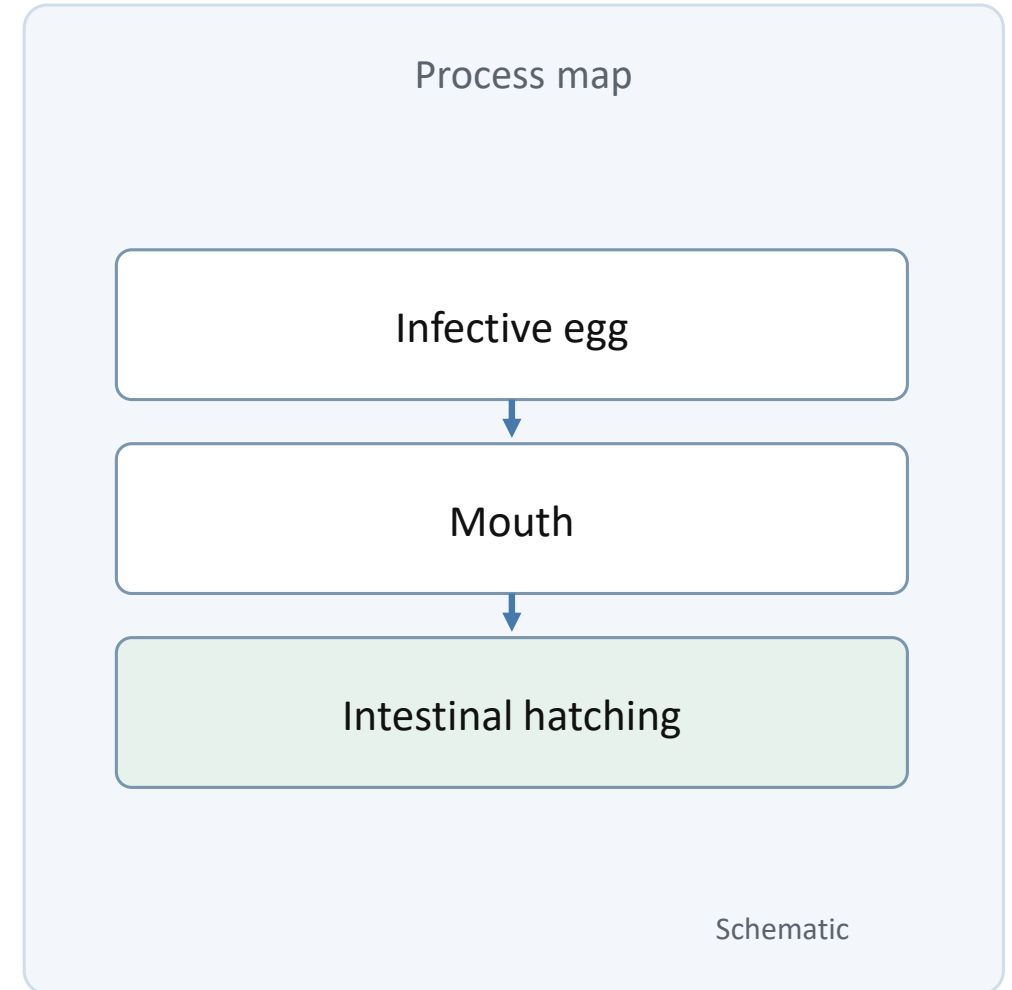
Life cycle: Four important compartments

- Infective eggs are swallowed
- Larvae hatch in the small intestine
- Adults establish in the cecum/colon
- Gravid females migrate to perianal skin to lay eggs



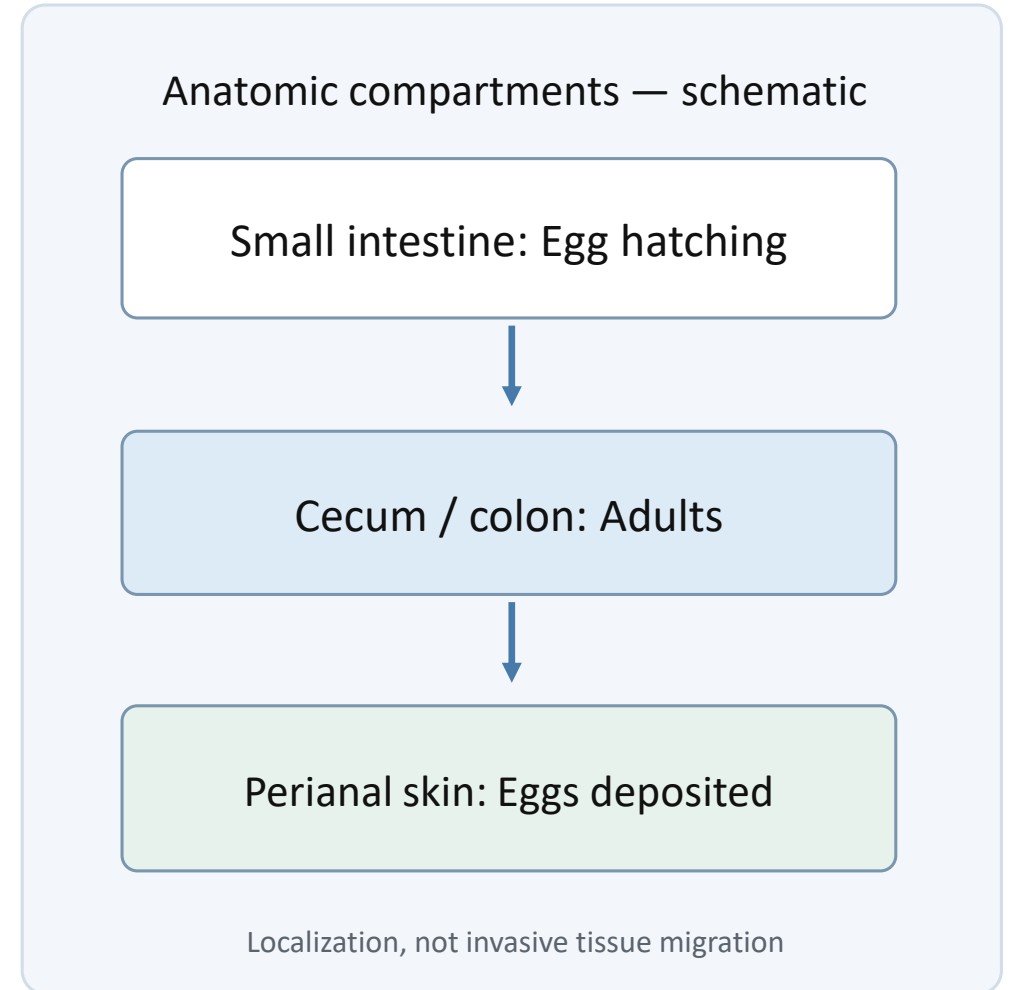
Step 1: Ingestion is the infective entry

- Humans acquire infection from embryonated eggs
- Hands are the principal connection between perianal contamination and mouth
- Infection does not require an intermediate host



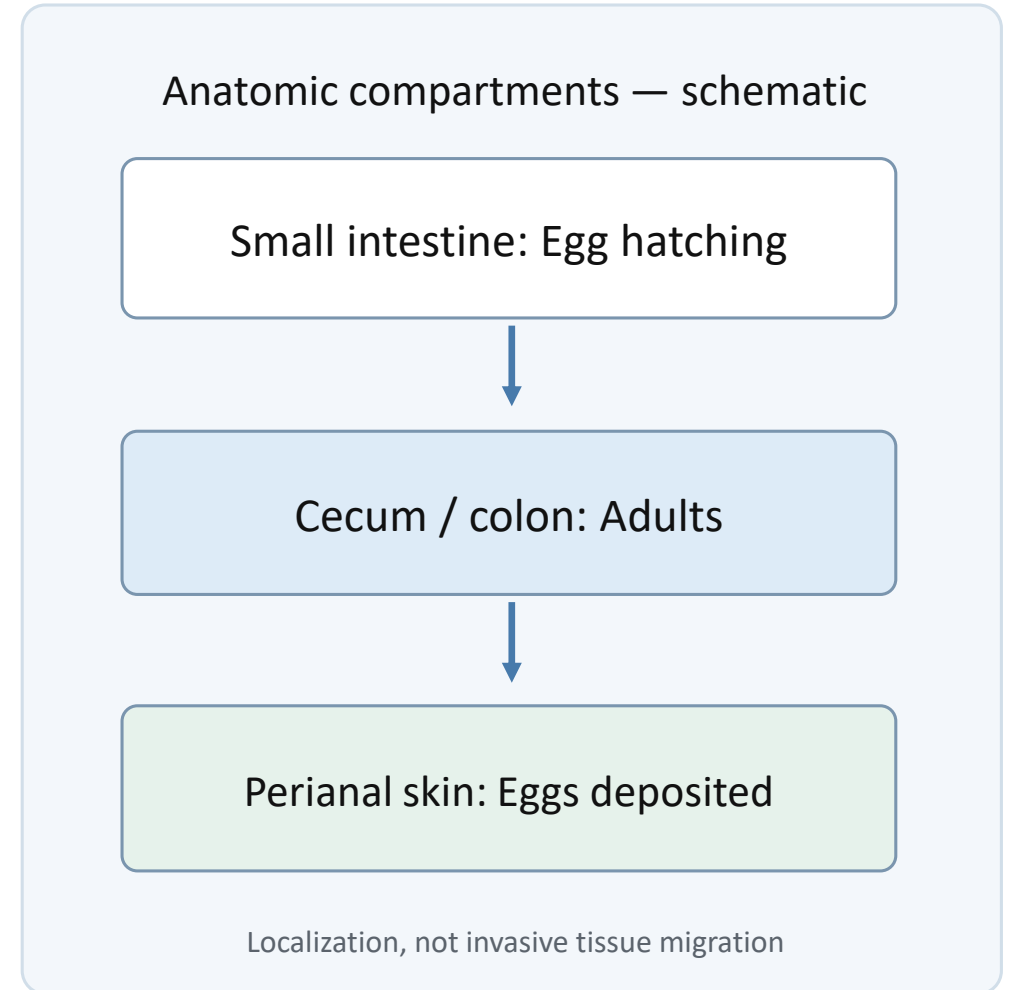
Step 2: Larvae hatch in the small bowel

- Ingested eggs release larvae in the small intestine
- Larvae proceed toward the large bowel during maturation
- The usual human cycle lacks systemic lung migration



Step 3: Adult habitat is the large bowel

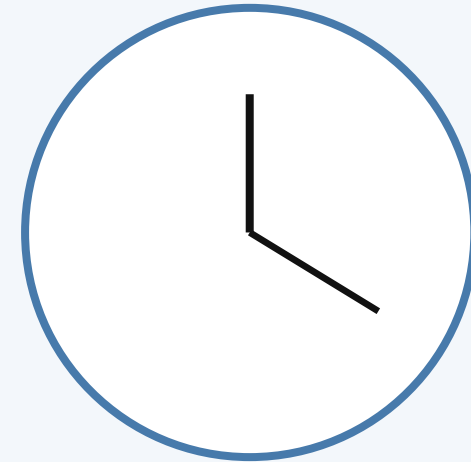
- Adults establish predominantly in the cecum
- The adult stage is chiefly luminal rather than tissue-invasive
- A low burden can therefore produce little mucosal injury



Step 4: Gravid females migrate at night

- Females move out through the anus while the host sleeps
- Eggs are deposited on the perianal folds
- This timing provides the basis for overnight symptoms and morning testing

Clock time matters diagnostically



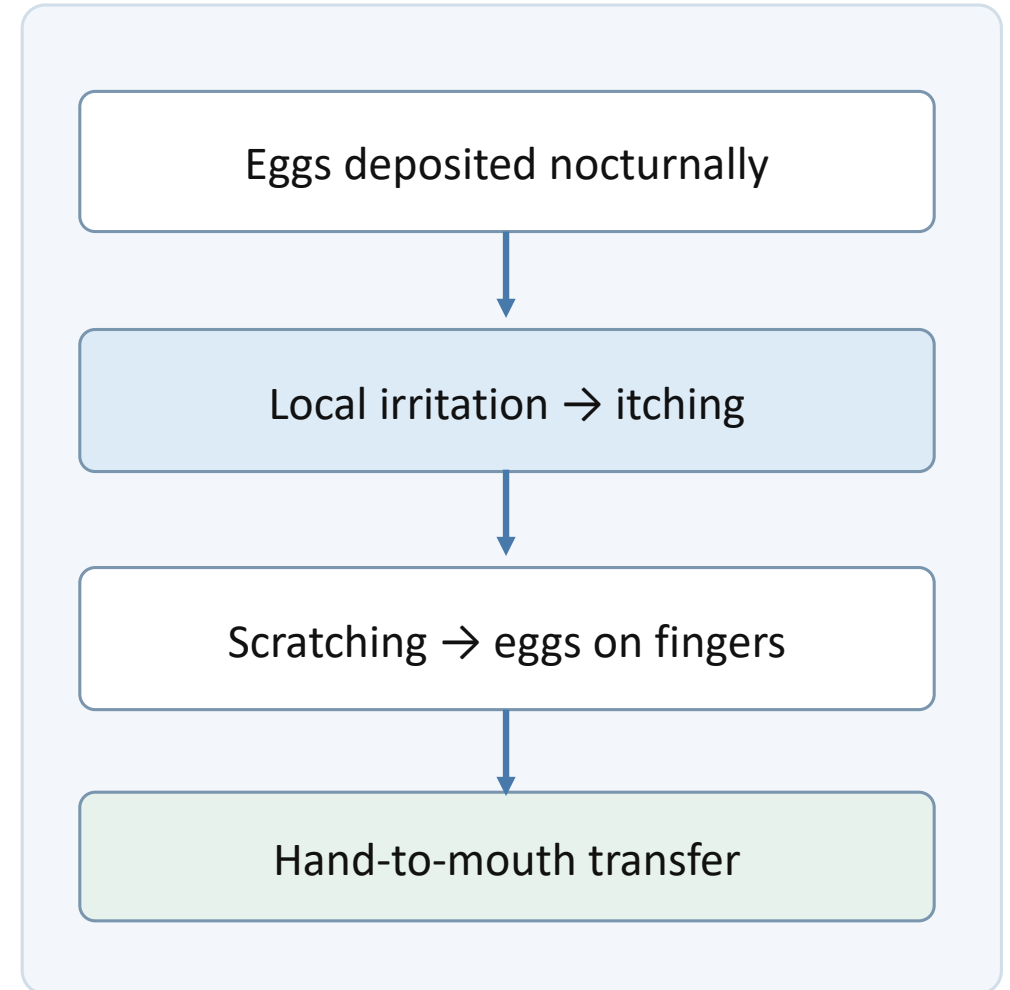
Night

Female migration and egg laying

Early-morning tape test: Before washing

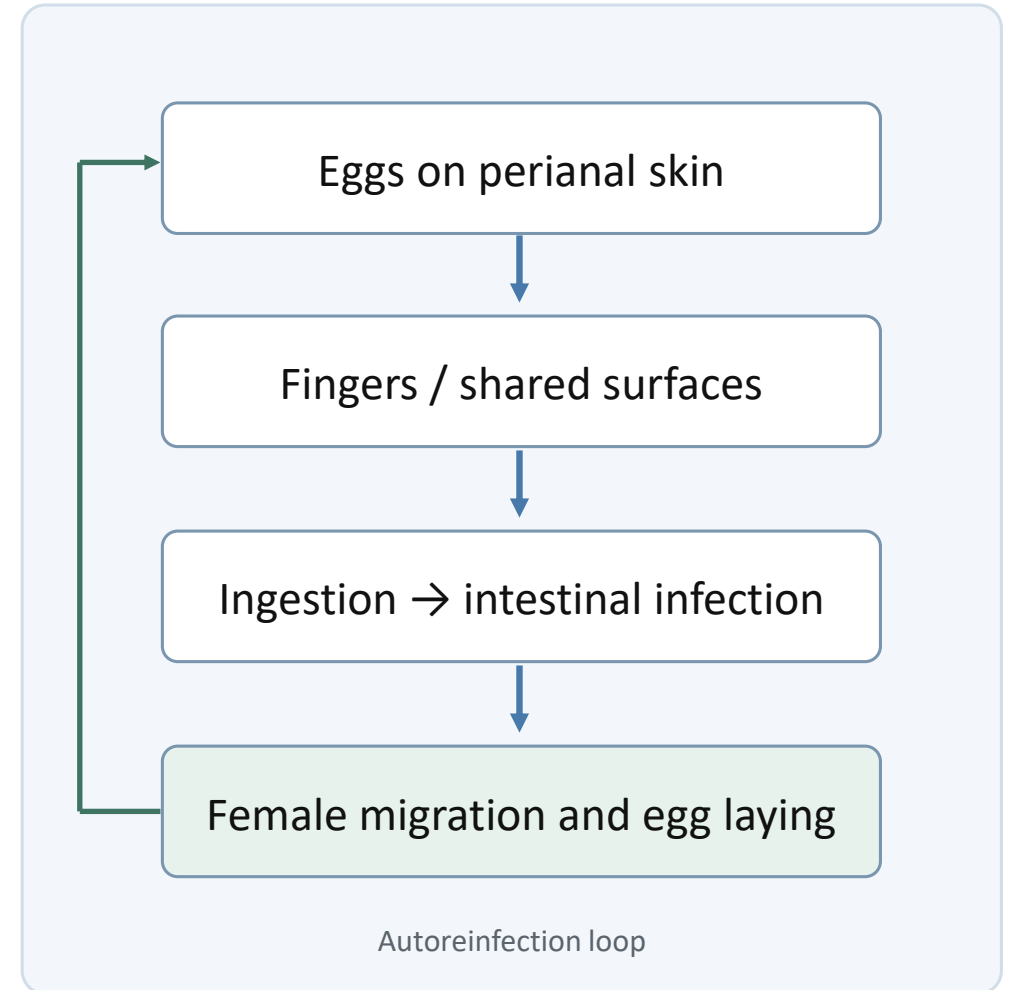
Step 5: The perianal egg reservoir

- Eggs remain adhered to perianal skin
- Irritation triggers scratching and secondary contamination
- The site of deposition is also the best diagnostic sampling site



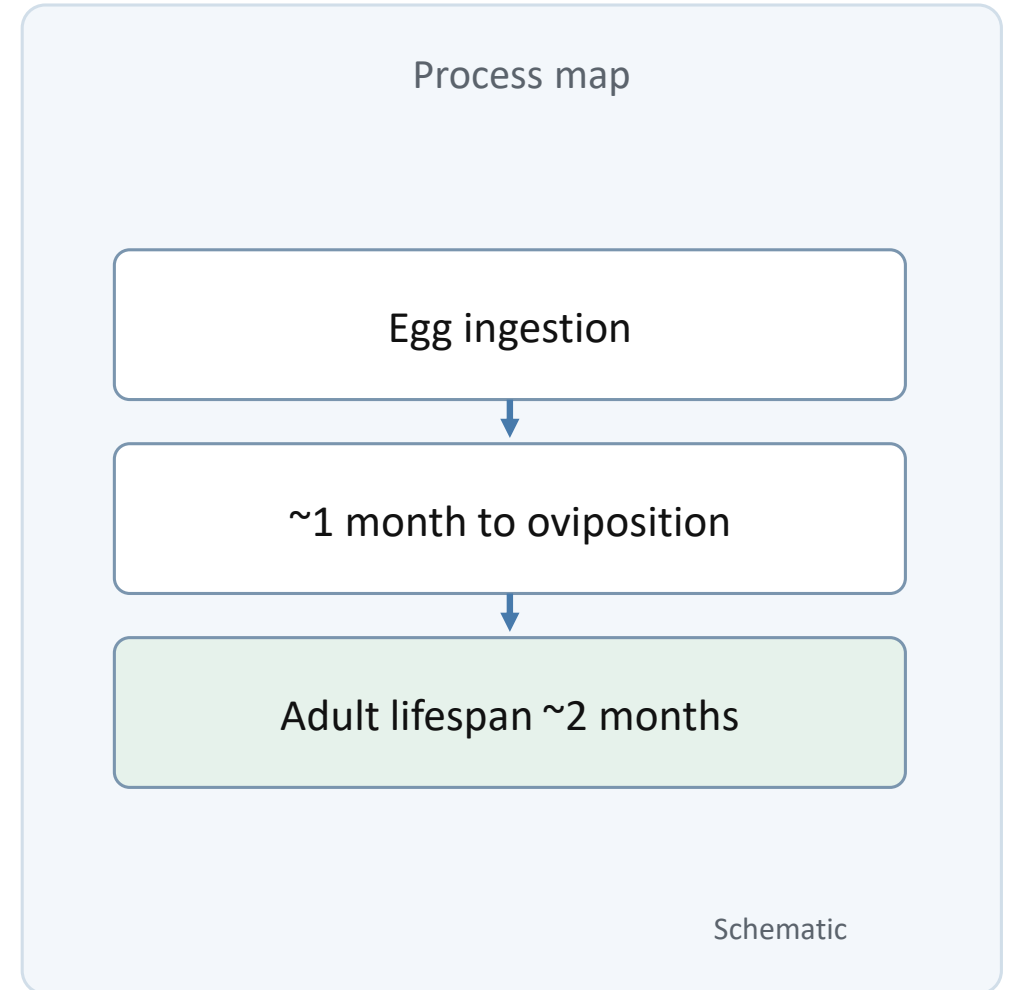
Autoreinfection closes the cycle

- Repeated hand-to-mouth transfer can infect the same individual
- Environmental eggs can infect other household members
- Persistent exposure must be addressed alongside drug therapy



Lifecycle timing: Two different clocks

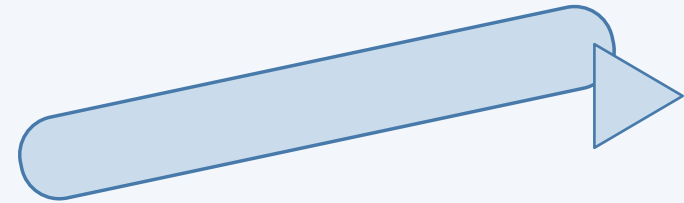
- CDC DPDx: About one month from egg ingestion to oviposition
- Adult worm life span is roughly two months
- Eggs may become infective much sooner under favorable conditions



Adult worms: Sexual dimorphism

- Gravid females are larger and have a long pointed tail
- Males are shorter with a blunt posterior end
- Sex-specific morphology is relevant to whole-worm recognition

Adult size and posterior contour



Female: 8–13 mm; Pointed tail

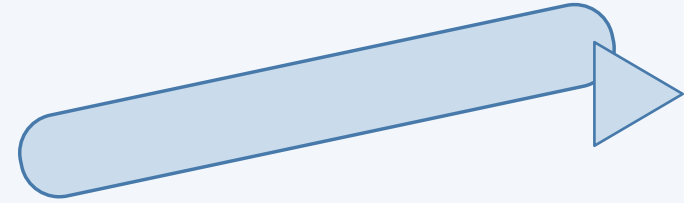


Male: 2–5 mm; Blunt posterior

Female and male adult sizes

- Adult female length: Approximately 8–13 mm
- Adult male length: Approximately 2–5 mm
- A female may be visible macroscopically near the anus

Adult size and posterior contour



Female: 8–13 mm; Pointed tail

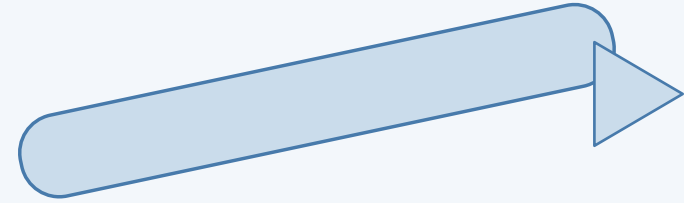


Male: 2–5 mm; Blunt posterior

Adult anterior anatomy

- Cephalic expansions are present in both sexes
- CDC DPDx describes a muscular and bulbous esophagus
- Features can support identification of intact adult worms

Adult size and posterior contour



Female: 8–13 mm; Pointed tail

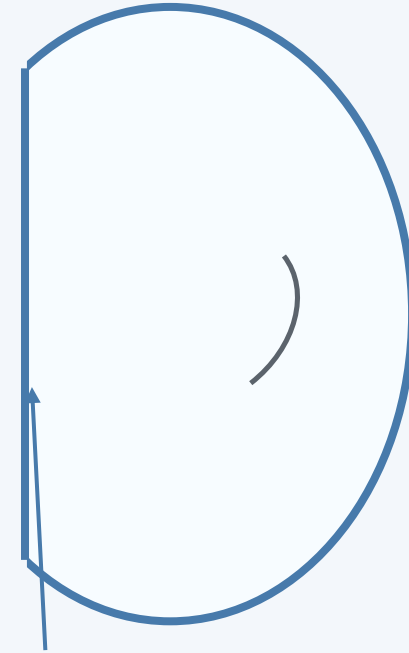


Male: 2–5 mm; Blunt posterior

Pinworm eggs: Diagnostic dimensions

- Typical egg dimensions are 50–60 × 20–30 µm
- Eggs are colorless to transparent
- Oval/elongate outline and asymmetry are characteristic

Asymmetric pinworm egg



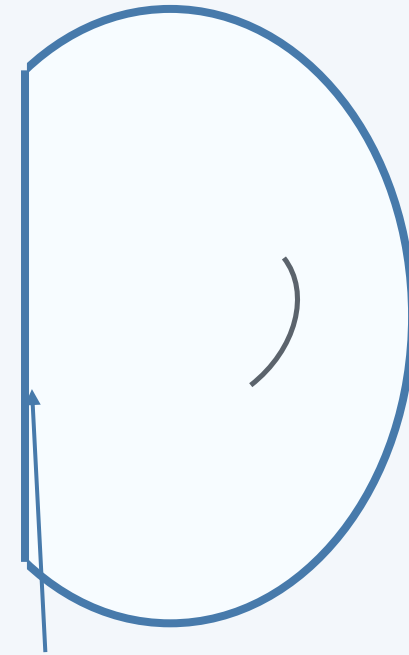
Flattened side

Schematic — not microscopy

One flattened side is a critical clue

- Eggs show a flattened (plano-convex) side
- Opposite border is more convex
- Examine outline rather than relying on staining intensity

Asymmetric pinworm egg



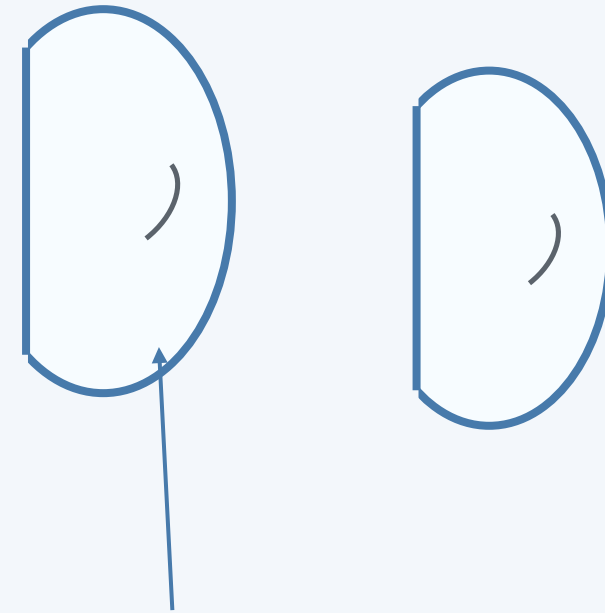
Flattened side

Schematic — not microscopy

Egg internal contents and shell

- A thin smooth shell surrounds the developing embryo
- Eggs are often partially embryonated when first deposited
- Some specimens show a developed larva internally

Pinworm eggs — conceptual shapes



Flattened side

Schematic — not microscopy

Where are eggs most abundant?

- Perianal collection follows the site of oviposition
- Feces contain eggs less consistently than the perianal sample
- Correct specimen selection outweighs indiscriminate testing

Cellulose-tape collection workflow

Clear tape: Adhesive surface



Apply to perianal skin

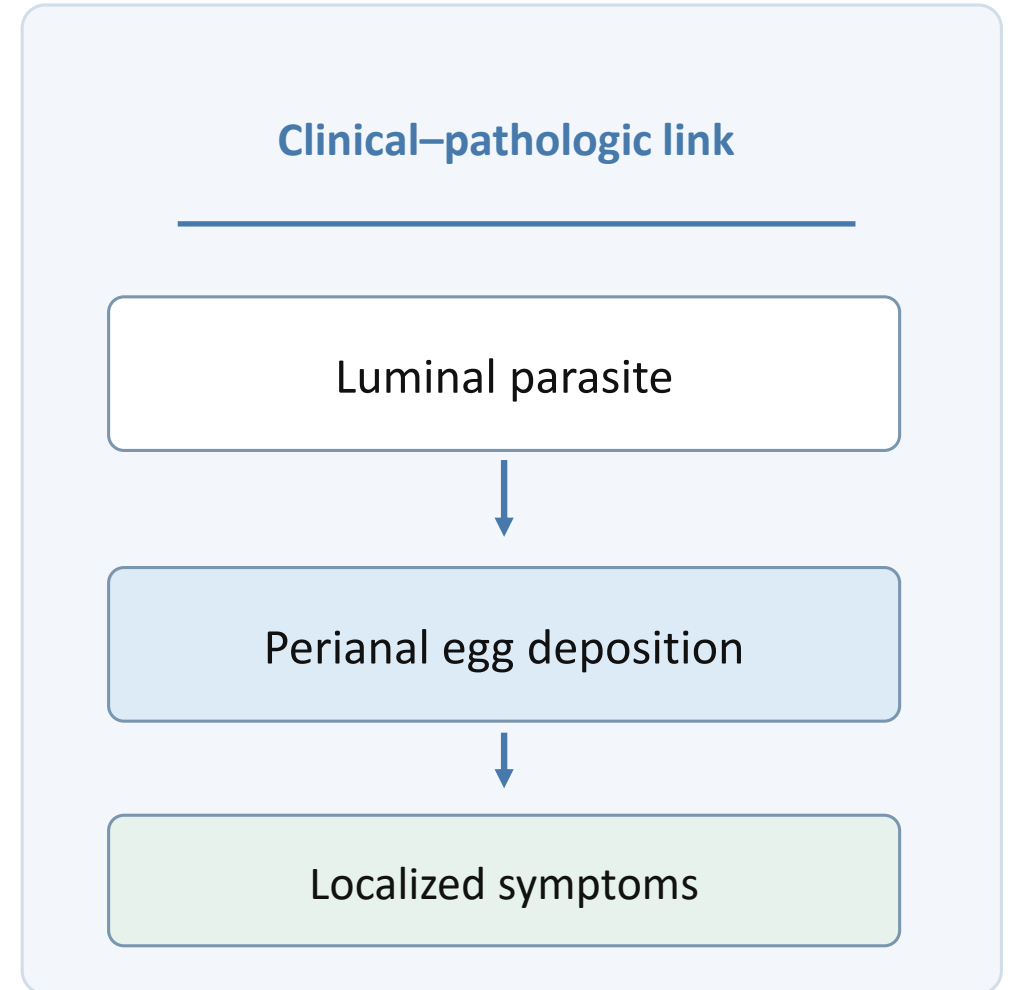


Place on slide; Examine

Schematic

The characteristic pathogenesis is local

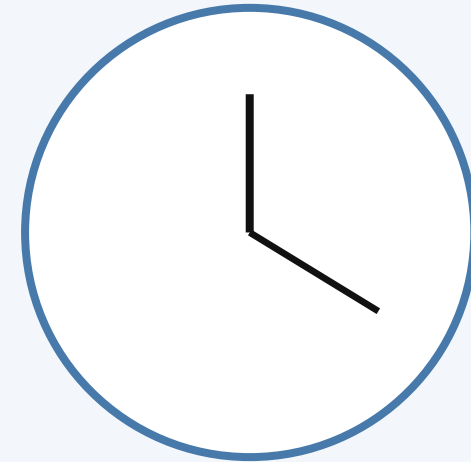
- Typical worms do not invade intestinal mucosa
- Egg deposition on skin provokes local irritation
- Severe tissue-destructive enterocolitis is not the usual phenotype



Why itching peaks at night

- Nocturnal female migration deposits eggs on perianal skin
- Adhesive eggs and local irritation stimulate scratching
- The cycle can disrupt sleep without severe gut pathology

Clock time matters diagnostically



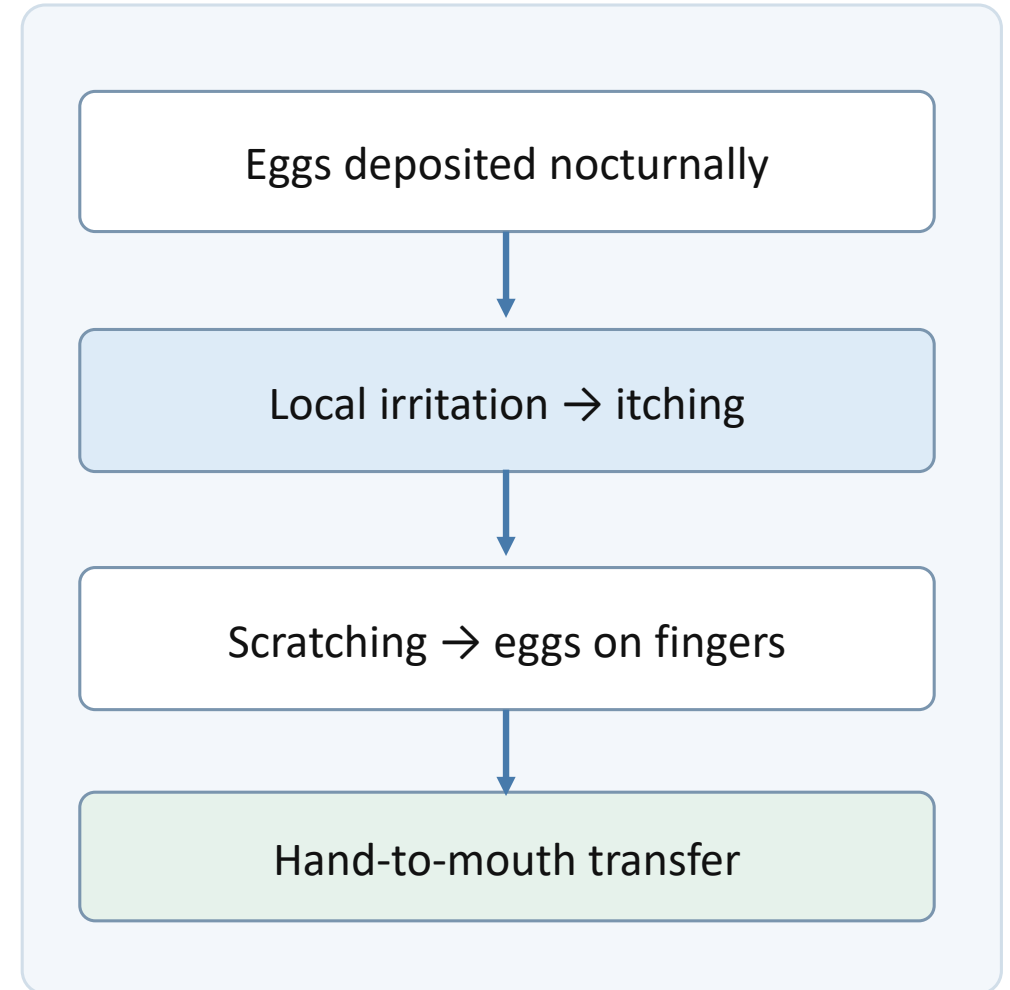
Night

Female migration and egg laying

Early-morning tape test: Before washing

Pruritus can cause a secondary skin lesion

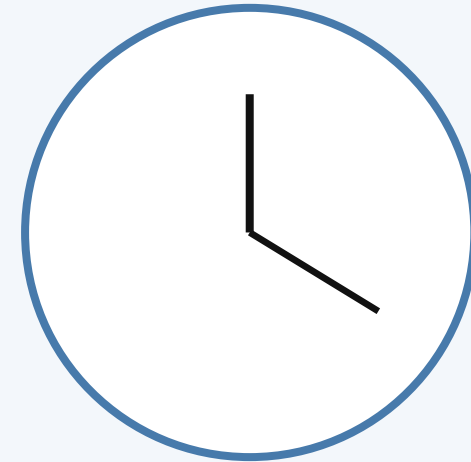
- Repeated scratching may produce excoriation
- Broken skin may develop secondary bacterial infection
- Interpret secondary skin inflammation separately from intestinal invasion



Sleep and behavioral consequences

- Nocturnal itching can interrupt sleep
- Restlessness and irritability may be secondary consequences
- Associated complaints are nonspecific without direct parasite evidence

Clock time matters diagnostically



Night

Female migration and egg laying

Early-morning tape test: Before washing

Asymptomatic infection is common

- Many infected people report no symptoms
- Absence of pruritus does not exclude the parasite
- Symptoms must be correlated with exposure history and targeted testing

Clinical–pathologic link

Luminal parasite



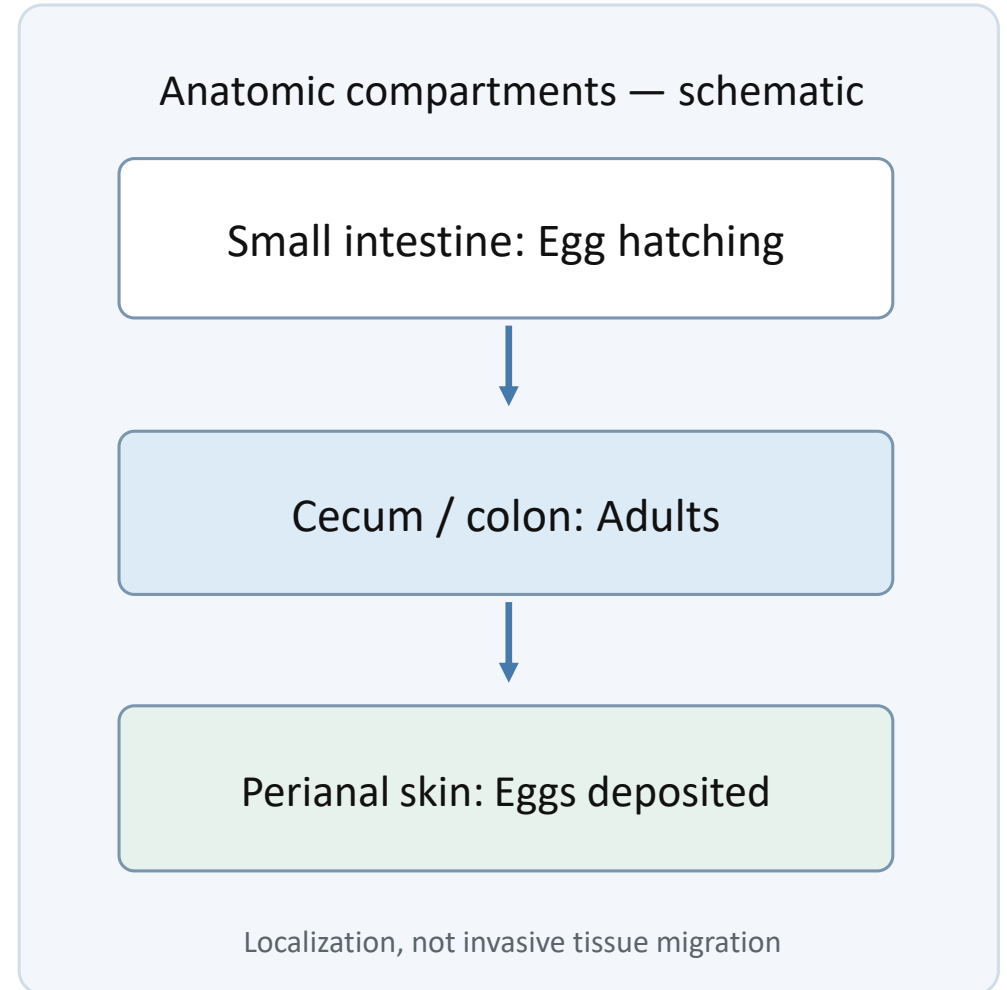
Perianal egg deposition



Localized symptoms

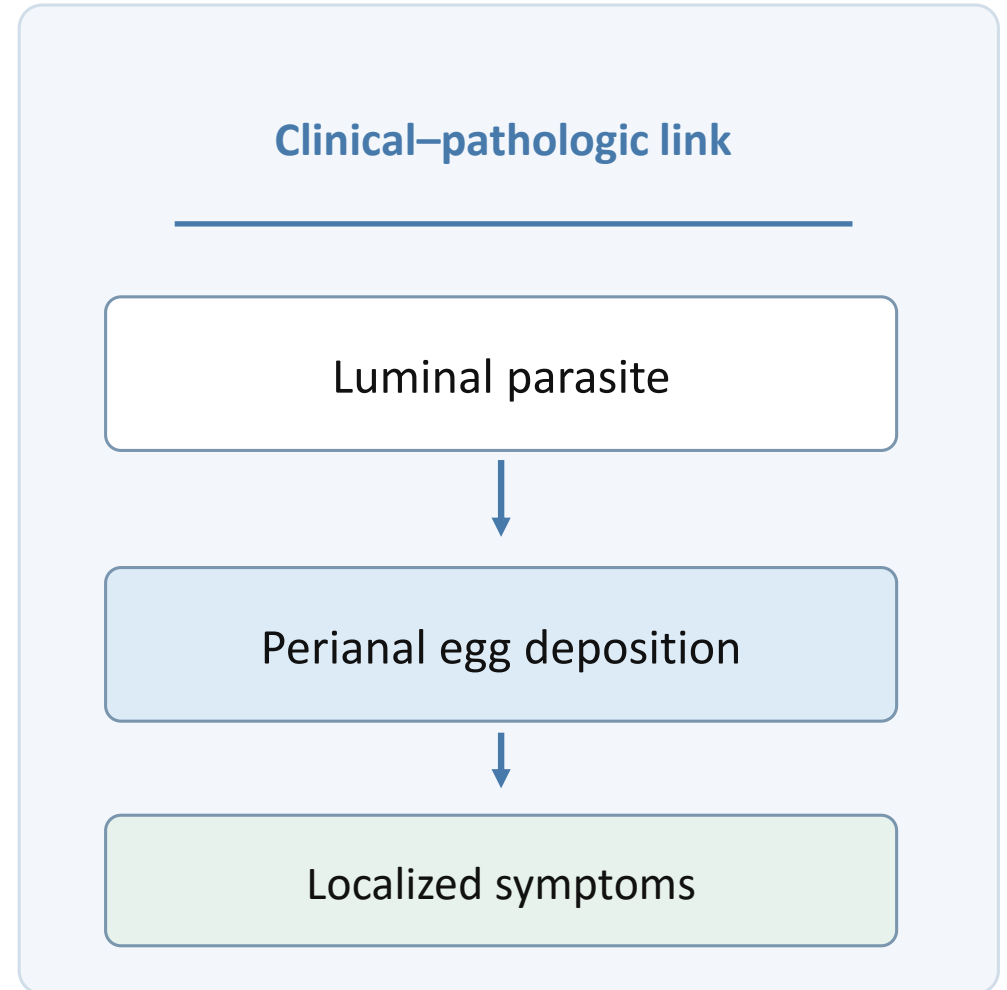
Occasional genital tract migration

- Adult worms may migrate to the vulvovaginal region
- Vulvovaginitis may accompany irritation or inflammation
- Such migration is exceptional relative to simple luminal infection



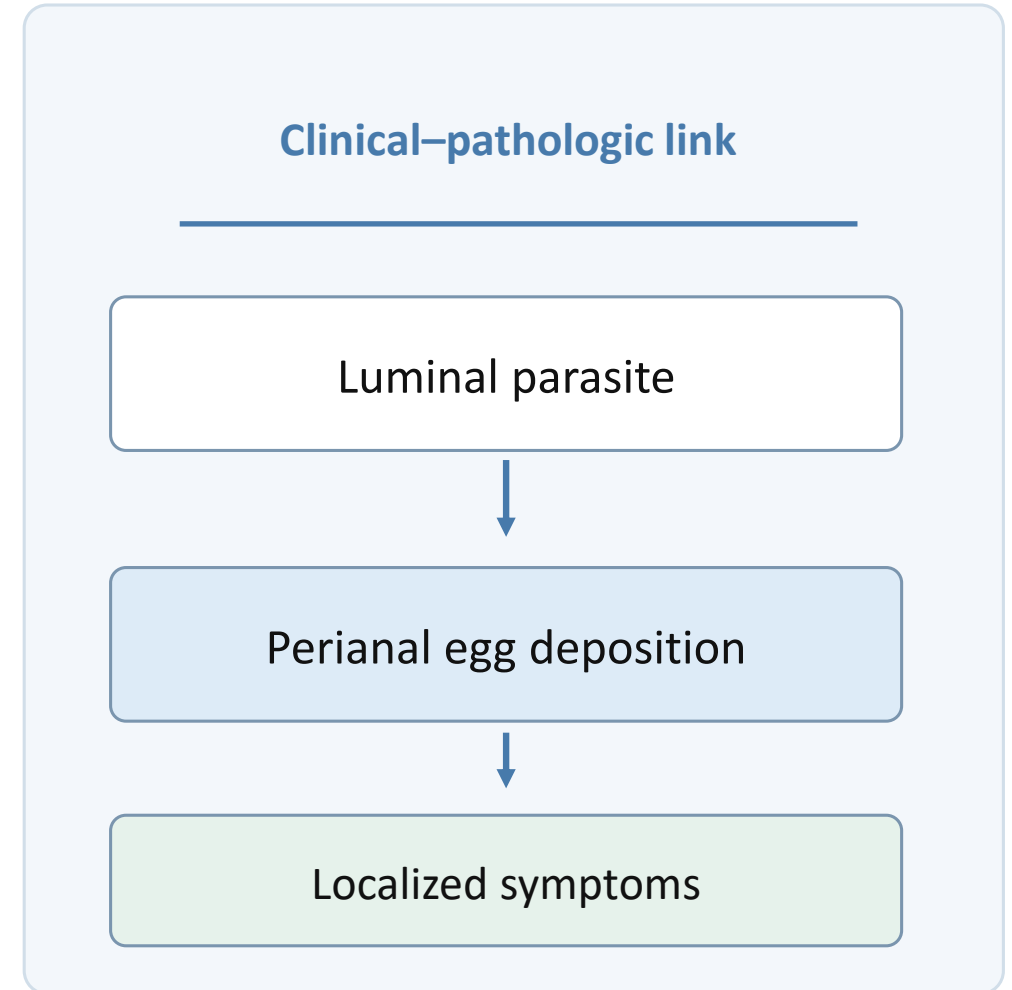
Rare ectopic inflammatory pathology

- CDC describes rare pelvic/peritoneal granulomatous reactions
- Tissue findings require careful morphologic correlation
- Do not generalize rare ectopic disease to routine enterobiasis



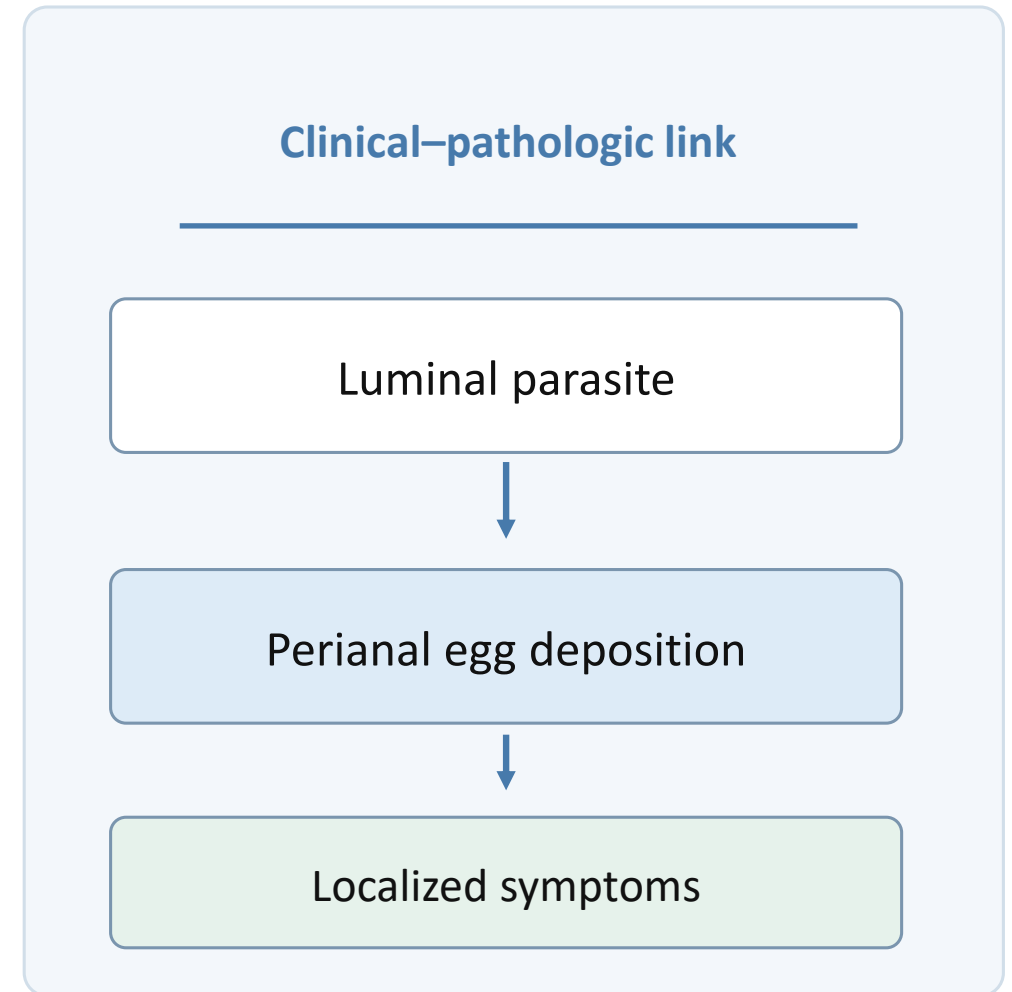
Enterobius and the appendix: Interpret carefully

- Worms may be found in appendectomy material
- Abdominal pain may resemble appendicitis
- Causality for acute appendicitis remains controversial



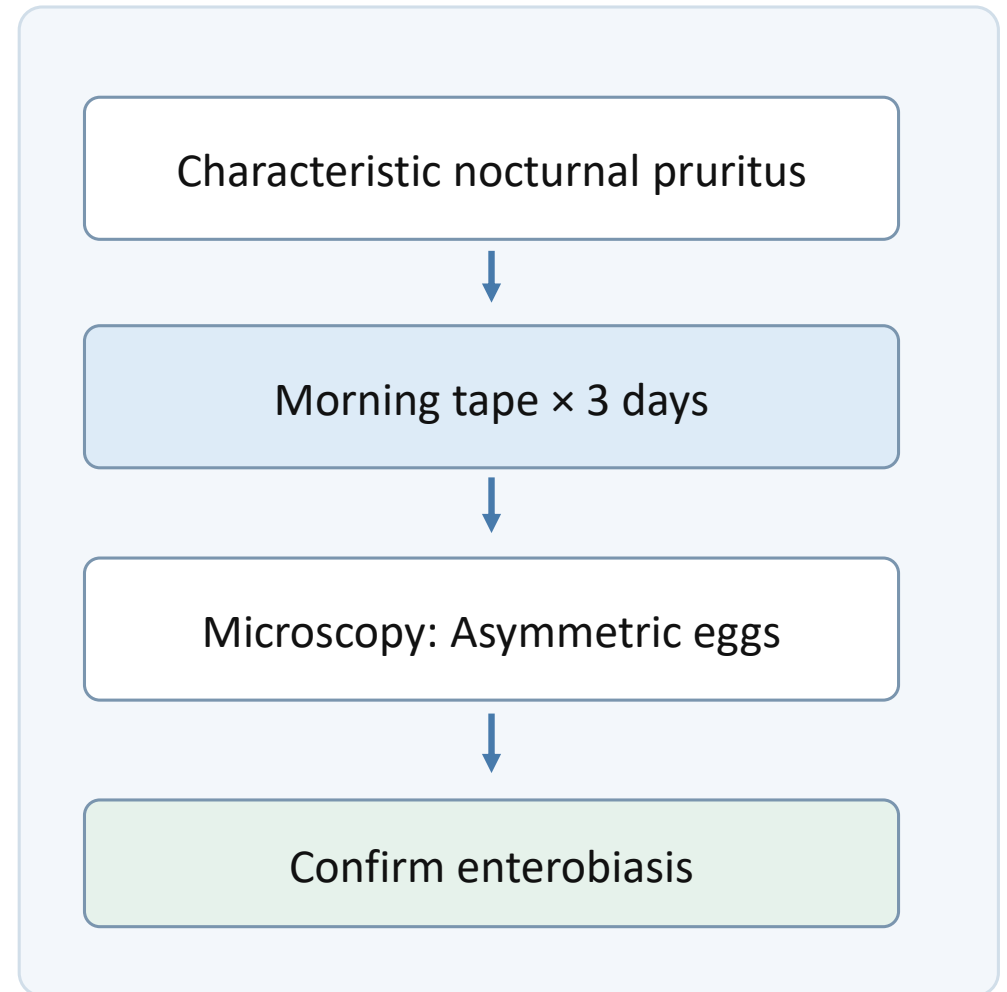
Tissue eosinophils are context-dependent

- Usual luminal enterobiasis causes little deep tissue injury
- Rare eosinophilic ileocolitis has been reported
- Prominent tissue eosinophilia is not a required diagnostic criterion



Choosing the diagnostic sample

- Suspected enterobiasis: Perianal cellulose tape is preferred
- Collect eggs where female worms deposit them
- Routine stool microscopy has lower utility for this particular nematode



The tape test: First-morning technique

- Press transparent adhesive tape to perianal folds
- Sample before defecation, bathing or washing
- Transfer tape to an appropriate slide/container for microscopy

Cellulose-tape collection workflow

Clear tape: Adhesive surface



Apply to perianal skin



Place on slide; Examine

Schematic

Why use three consecutive mornings?

- Eggs may not be collected on every single morning
- CDC recommends a tape test on three mornings in a row
- Repeated collection increases the chance of finding eggs

Cellulose-tape collection workflow

Clear tape: Adhesive surface



Apply to perianal skin



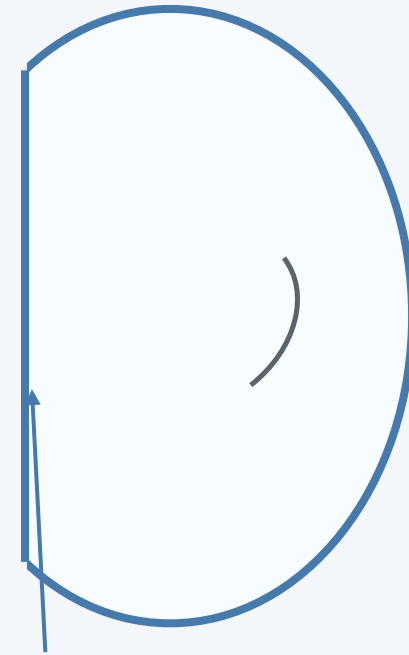
Place on slide; Examine

Schematic

Microscopic recognition on tape

- Look for clear asymmetrical oval eggs
- Identify the characteristic flattened side
- Confirm the finding with a laboratory-validated examination

Asymmetric pinworm egg



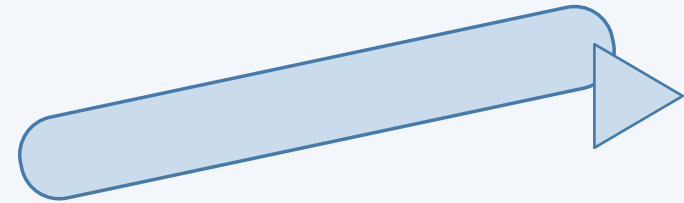
Flattened side

Schematic — not microscopy

Direct worm observation is also diagnostic

- Gravid worms can sometimes be found perianally at night
- CDC suggests checking 2–3 hours after the person falls asleep
- The finding is useful when an actual adult worm is visualized

Adult size and posterior contour



Female: 8–13 mm; Pointed tail



Male: 2–5 mm; Blunt posterior

Why routine stool tests often miss pinworms

- Most eggs are placed on perianal skin rather than passed with feces
- Stool samples can occasionally contain eggs or adult worms
- A negative stool test does not substitute for targeted perianal collection

Cellulose-tape collection workflow

Clear tape: Adhesive surface



Apply to perianal skin



Place on slide; Examine

Schematic

Test selection across common nematodes

- Enterobius: Perianal egg collection
- Ascaris and Trichuris: Stool egg detection
- Strongyloides: Larval detection, different transmission biology

ENTEROBIUS

Fecal–oral eggs • Perianal egg collection • Pruritus dominant

ASCARIS

Fecal–oral eggs • Stool ova • Tissue migration

STRONGYLOIDES

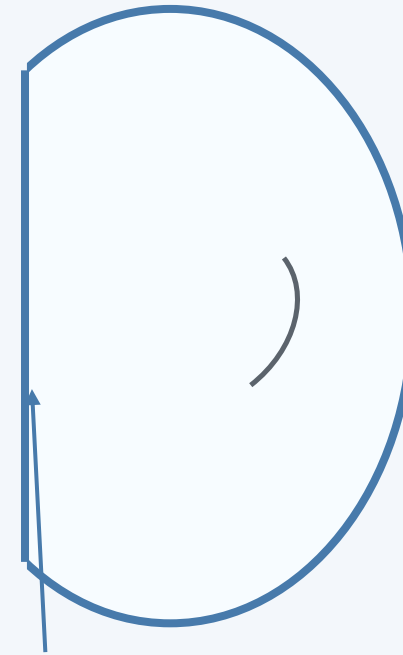
Skin-penetrating larvae • Stool larvae • Autoinfection possible

Differential comparison, not equivalent disease burdens

Reading intestinal tissue cautiously

- Adult worms or eggs may be encountered incidentally in biopsies
- Tissue parasite morphology needs distinction from artifact
- A positive tissue finding does not independently prove invasive disease

Asymmetric pinworm egg



Flattened side

Schematic — not microscopy

Laboratory handling and biosafety

- Eggs may be adhesive and infectious
- Use standard precautions for tape and stool samples
- Avoid contamination of work surfaces and accidental ingestion

Cellulose-tape collection workflow

Clear tape: Adhesive surface



Apply to perianal skin



Place on slide; Examine

Schematic

Treatment strategy: Target worms and exposure

- CDC lists mebendazole, albendazole and pyrantel pamoate
- These drugs treat worms but not eggs
- Environmental and contact management remain essential

Why the second dose matters

Day 0: Active worms targeted



Eggs are not reliably killed



Two weeks: Repeat treatment

The rationale for a second treatment dose

- A second dose is recommended two weeks after the first
- Eggs left after the first dose can later hatch
- The repeat dose targets newly developed worms

Why the second dose matters

Day 0: Active worms targeted



Eggs are not reliably killed



Two weeks: Repeat treatment

Treating contacts reduces cycling

- Household members and caretakers are commonly exposed
- CDC recommends simultaneous treatment of affected households and caregivers
- Institutional control may require coordinated treatment

Hands and short clean nails

Morning bathing + clean clothing

Bedding and laundry hygiene

Simultaneous household management

Hand hygiene is the central intervention

- Wash hands with soap and warm water
- Especially after toilet use, diaper changes and before food handling
- Keep fingernails short and clean; Avoid nail biting and scratching

Hands and short clean nails

Morning bathing + clean clothing

Bedding and laundry hygiene

Simultaneous household management

Morning hygiene and laundry control

- Morning bathing helps remove eggs deposited overnight
- Change underwear and nightclothes regularly
- Handle bedding without shaking and launder adequately

Hands and short clean nails

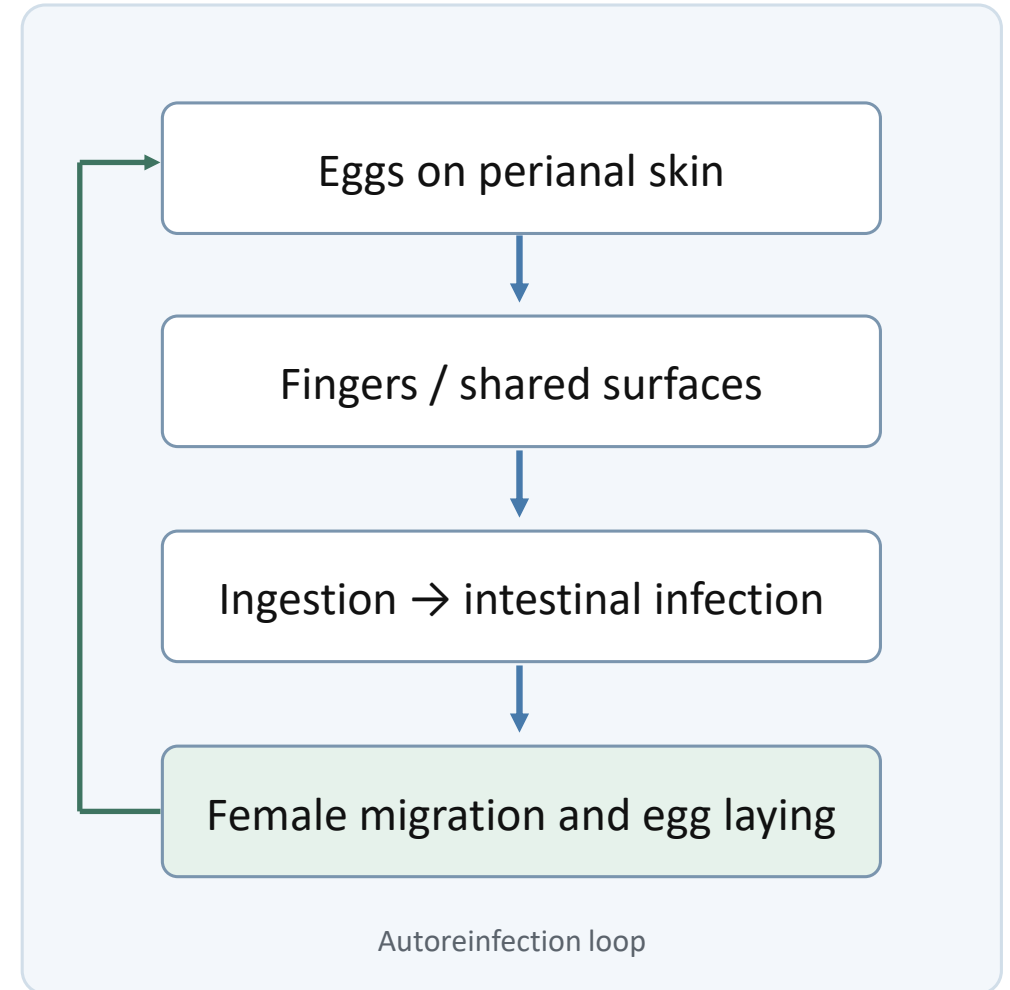
Morning bathing + clean clothing

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Simultaneous household management

How recurrence occurs after therapy

- New ingestion of eggs causes reinfection
- Persistent contaminated materials sustain exposure
- Recurrence is not automatically evidence of drug resistance



Case application: Nocturnal pruritus

Illustrative clinical vignette

A 7-year-old has nighttime perianal itching. A routine stool examination is unrevealing. There are similar symptoms in a sibling.

Which specimen and collection timing best address the clinical question?

First-morning perianal tape collection on three consecutive mornings.

Case application: Pathology finding

Illustrative clinical vignette

A worm is reported in appendectomy tissue. The pathology request asks whether the parasite necessarily caused appendicitis.

What is the defensible clinicopathologic interpretation?

The parasite may be incidental; Causation of appendicitis remains uncertain.

Case application: Repeated household infection

Illustrative clinical vignette

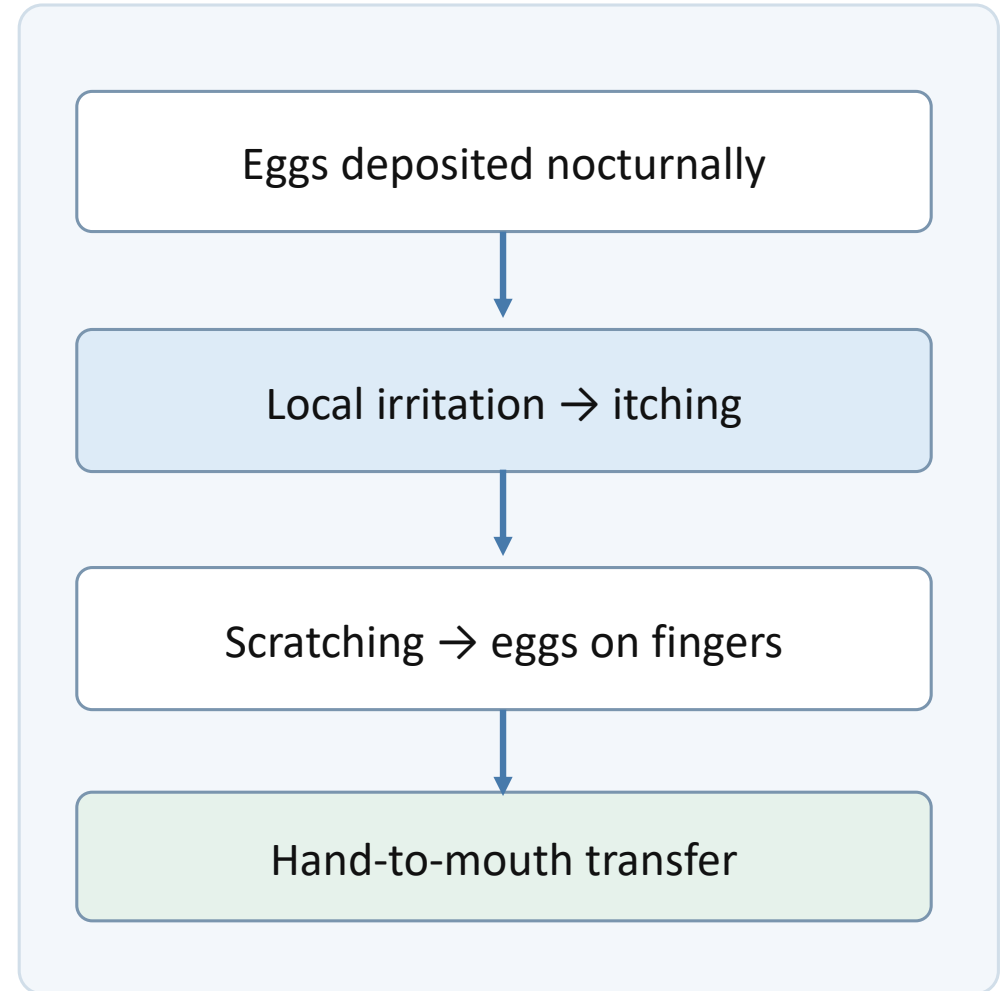
A child responds to treatment but again develops nocturnal itching within a household with recurrent cases.

Which transmission mechanism and prevention gap should be assessed?

Reingestion of environmental/perianal eggs and incomplete contact or hygiene control.

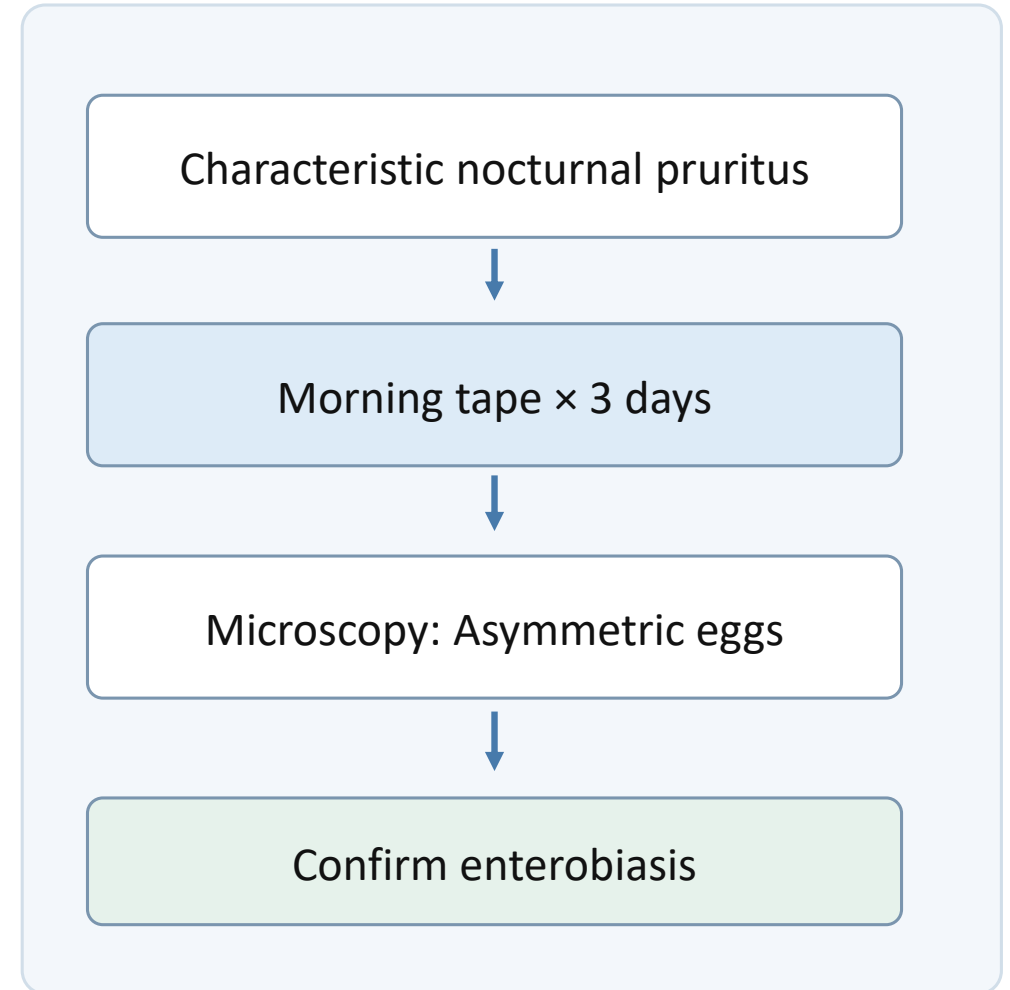
Integrated sequence: Parasite to symptom

- Infective egg → intestinal development → adult worm
- Female nocturnal migration → perianal oviposition
- Pruritus and scratching → oral reinfection or transmission



Integrated sequence: Symptom to test

- Nocturnal perianal pruritus raises suspicion
- Morning cellulose tape targets deposited eggs
- Asymmetrical eggs establish the laboratory diagnosis



Five distinctions worth retaining

- Primarily luminal rather than tissue-invasive nematode
- Nocturnal egg deposition explains symptoms and specimen site
- Plano-convex egg is the key microscopic form
- Repeat infection follows environmental and hand contamination
- *E. Gregorii* is a contested taxonomic designation

References and source scope

Robbins, Cotran & Kumar. Pathologic Basis of Disease, 11th ed. Chapter 17, p. 725.

CDC DPDx. Enterobiasis: life cycle, morphology and laboratory diagnosis.

CDC. Clinical Overview of Pinworm Infection (2024); About Pinworm Infection (2024).

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Hasegawa et al. J Parasitol 1998;84:131–134; molecular evidence PMID 16788831.