Hookworm (ancylostomiasis)

BASIC EPIDEMIOLOGY

Infectious Agent
Hookworm is a parasitic infection caused by the soil-transmitted helminths *Necator americanus* and *Ancylostoma duodenale* (rarely by other *Ancylostoma* species, e.g. *A. ceylanicum*).

Transmission
Transmission primarily occurs via the ingestion of soil contaminated with feces. Soil becomes contaminated with eggs shed in the feces of an individual infected with hookworm. The eggs must incubate in the soil for several days before they become infectious and are able to be transmitted to another person. Oral transmission can sometimes occur from consuming improperly washed food grown or exposed to soil contaminated with feces. Transmission can also occur (rarely) between a mother and her fetus/infant via infected placental or mammary tissue.

Incubation Period
Eggs must incubate in the soil for 5-10 days before they mature into infectious filariform larvae that can penetrate the skin. Within the first 10 days following penetration of the skin, filariform larvae will migrate to the lungs and occasionally cause respiratory symptoms. Three to five weeks after skin penetration the larvae will migrate to the intestinal tract where they will mature into an adult worm. Adult worms may live in the intestine for 1-5 years depending on the species.

Communicability
Human to human transmission of hookworm does NOT occur because part of the worm's life cycle must be completed in soil before becoming infectious. However, vertical transmission of dormant filariform larvae can occur between a mother and neonate via contaminated breast milk. These dormant filariform larvae can remain within in a host for months to years. Soil contamination is perpetuated by fecal contamination from infected individuals who can shed eggs in feces for several years after infection.

Clinical Illness
Hookworm infection is often asymptomatic. Immediately following infection, a pruritic, erythematous, papular rash commonly known as "ground itch" can develop at the penetration site, typically the feet or hands. In the first two weeks of infection, minor cough and throat irritation may occur as a result of larval migration but these symptoms are rare. Light infections produce few or no symptoms but can include abdominal discomfort, diarrhea, and/or blood in the stool. Severe infections can be characterized by more severe symptoms stemming primarily from intestinal blood loss resulting in anemia. Symptoms can include: nausea, fatigue, pale skin, and rarely congestive heart failure and death. In children, anemia resulting from infection can cause impaired growth and delayed mental development.

DEFINITIONS

Clinical Case Definition
Necator americanus and *Ancylostoma duodenale* are the main cause of hookworm infections worldwide. Most patients with hookworm are asymptomatic but severe and chronic cases are often characterized by hypochromic, microcytic anemia and hypoproteinemia. Complications due to anemia can result in severe fatigue, paleness, nausea, and diarrhea and can cause growth impairment and mental retardation in children.

Laboratory Confirmation

- Microscopic identification of *Ancylostoma* or *Necator* eggs in stool specimens, **OR**
- Microscopic identification of *Ancylostoma* or *Necator* species of larvae cultured from the stool, **OR**
- Identification of adult worms expelled after treatment, or removed during endoscopy

Case Classifications

- **Confirmed:** A case that is laboratory confirmed

SURVEILLANCE AND CASE INVESTIGATION

Case Investigation

Local and regional health departments should promptly investigate all reports of hookworm (ancylostomiasis). Investigations should include an interview of the case or a surrogate to get a detailed exposure history. Please use the Hookworm (ancylostomiasis) Investigation Form available on the DSHS website: http://www.dshs.texas.gov/idcu/investigation/

Note:

- If an imported case (acquired outside of Texas) of Hookworm is diagnosed/identified in a refugee with a current Texas address, it should be investigated and counted as a Texas case. If a case currently has an address outside of your jurisdiction or the refugee plans to move to another state or country, fax the available investigation information, with the new address, to DSHS EAIDU. This information will be forwarded to the appropriate jurisdiction.

Case Investigation Checklist

- ☐ Confirm laboratory results meet the case definition.
  - Eggs of *Necator americanus* and *Ancylostoma duodenale* species in stool specimens are indistinguishable during microscopic identification and would still be investigated.
- ☐ Review medical records or speak to an infection preventionist or healthcare provider to verify case definition, identify possible risk factors and describe course of illness.
- ☐ Interview the case to get detailed exposure history and risk factor information.
  - Use the **Hookworm (ancylostomiasis) Investigation Form** to record information from the interview.
  - If the case is not available or is a child, conduct the interview with a surrogate who would have the most reliable information on the case, such as a parent or guardian.
  - Provide education to the case or his/her surrogate about effective hand washing, food safety practices, and avoidance of soil contamination. See Prevention and Control Measures.
- ☐ Fax completed forms to DSHS EAIDU at **512-776-7616**.
  - For lost to follow-up (LTF) cases, please complete as much information as possible obtained from medical/laboratory records (e.g., demographics, symptomology, onset date, etc.) on investigation form and fax/e-mail securely to DSHS EAIDU and indicate the reason for any missing information.
- ☐ If case is part of an outbreak or cluster, see Managing Special Situations section.
- ☐ All confirmed case investigations must be entered and submitted for notification in the NEDSS Base System (NBS). Please refer to the *NBS Data Entry Guidelines* for disease specific entry rules.

Prevention and Control Measures

- Routine hand washing with soap and warm water.
- Proper disposal of human waste products such as feces is necessary to prevent contamination of soil.

- Avoid areas where human waste contamination of soil or water is likely.
- Wear shoes or other clothing to prevent contact with soil.
- Thoroughly wash fruits and vegetables to remove soil/fertilizer residue.

Exclusions
Human-to-human transmission is rare and has only been documented from nursing mothers to neonates via breast milk, therefore no exclusion from work, school or daycare is required for disease control purposes unless the individual has diarrhea. If the individual has diarrhea, the standard exclusion until diarrhea free for 24 hours without the use of diarrhea suppressing medications applies. Diarrhea is defined as 3 or more episodes of loose stools in a 24-hour period.

MANAGING SPECIAL SITUATIONS

Outbreaks/Clusters
If an outbreak or cluster is suspected, notify the DSHS Emerging and Acute Infectious Disease Branch (EAIDU) at **(512) 776-7676**.

The local/regional health department should:

- Interview all cases suspected as being part of the outbreak or cluster.
- Request medical records for any case in your jurisdiction that died, was too ill to be interviewed, or for whom there are no appropriate surrogates to interview.
- Prepare a line list of cases in your jurisdiction. Minimal information needed for the line list might include patient name or other identifier, DSHS or laboratory specimen identification number, specimen source, date of specimen collection, date of birth, county of residence, date of onset (if known), symptoms, underlying conditions, treatments and outcome of case, and risky exposures, such as inadequate waste disposal near the home or work, recreational activities in areas with inadequate waste disposal, or travel to an endemic country reported by the case or surrogate.

Line list example:

ID	Name	Age	Sex	Ethnicity	Onset	Symptoms	Risks	Notes
1	NT	34	F	White/non-Hispanic	12/4/16	Diarrhea, Anemia	Lived in Vietnam last 5 years, currently lives in same neighborhood as ID 2	Brother ill
2	PR	4	M	Unknown	11/30/16	Anemia, bloody stool	Poor sanitation near home, lives in same neighborhood as ID 1	Lost to follow up (LTF)

- If the outbreak was reported in association with an apparent common risk factor (e.g., work or live near a possible site of soil contamination, members of the same household with similar travel), recommend that anyone displaying symptoms seek medical attention from a healthcare provider.
- If several cases in the same family or geographic area are identified and there is a possibility for similar exposures (e.g., travel to the same country, poor sanitation), testing of potentially exposed persons or mass de-worming treatment may be warranted.

REPORTING AND DATA ENTRY REQUIREMENTS

Provider, School, Child-Care Facility, and General Public Reporting Requirements
Confirmed, probable and clinically suspected cases are required to be reported **within 1 week** to

the local or regional health department or the Texas Department of State Health Services (DSHS), Emerging and Acute Infectious Disease Branch (EAIDU) at **(512) 776-7676**.

Local and Regional Reporting and Follow-up Responsibilities
Local and regional health departments should:

- Enter the case into NBS and submit an NBS notification on all **confirmed** cases.
    - Please refer to the *NBS Data Entry Guidelines* for disease-specific entry rules.
    - A notification can be sent as soon as the case criteria have been met. Additional information from the investigation may be entered upon completing the investigation.
- Fax completed forms to DSHS EAIDU at **512-776-7616** or email securely to an EAIDU epidemiologist.

When an outbreak is being investigated, local and regional health departments should:

- Report outbreaks within 24 hours of identification to the regional DSHS office or to EAIDU at **512- 776-7676.**

LABORATORY PROCEDURES

Fecal Ova and Parasite testing for helminth eggs (fecal O&P examination) is widely available from most private laboratories, and if needed, DSHS laboratory is available for specimen submission. Adult worm specimen identification may not be available at private laboratories therefore submission to the DSHS laboratory is available and highly recommended. Contact an EAIDU epidemiologist to discuss further.

Specimen Collection

- Submit a stool specimen in an O&P stool collection kit (5-10 % formalin & Zn-PVA fixatives).
    - Required volume: Stool 5 g solid or 5 mL liquid.
- Adult worms should be submitted in either 5-10% formalin or 70% ethanol.

Submission Form

- Use DSHS Laboratory G-2B form for specimen submission.
- Make sure the patient's name and date of birth or medical number match exactly what is written on the transport tubes.
- Fill in the date of collection, date of onset, diagnosis/symptoms, and all required fields.

Specimen Shipping

- Transport temperature: May be shipped at ambient temperature.
- Ship specimens via overnight delivery.
- DO NOT mail on a Friday, or state holidays, unless special arrangements have been pre-arranged with DSHS Laboratory.
- Ship specimens to:

  Laboratory Services Section, MC-1947 Texas Department of State Health Services 1100 West 49th Street
  Austin, TX 78756-3199
  Attn. Walter Douglass (512) 776-7569

Possible Causes for Rejection:

- Specimen not in correct transport medium.
- Missing or discrepant information on form/specimen.
- Transport media was expired.
- Unpreserved specimen received greater than 24 hours after collection. (Specimen may still

be submitted as an attempt will be made to complete testing on compromised material.)
- Call Medical Parasitology Lab (512) 776-7560 with specific questions about specimen acceptance criteria.

REVISION HISTORY

March 2021
- Minor updates