Threadworms and other helminths
Adult helminth parasites are large, multicellular organisms, which have an elongated, flat or round body.

See page 4, Facts Behind the Fact Card: Threadworms and other helminths

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Recognising and treating threadworms

By Anna Ezzy, MPS

This issue of inPHARMation focuses on threadworm and other helminth (worm) infections.

Pinworm infections (also known as threadworms) are the most common worm infection in Australia, and often treated in the pharmacy using a variety of over-the-counter medicines. Pharmacists and pharmacy staff play an important role in assisting customers to treat threadworms, from providing advice on recognising infection, to recommending medicines and self care practices to prevent transmission and reinfection.

Threadworm infections are most common in school-aged children. Common symptoms include itch around the anus (especially at night), irritability, sleeplessness, nausea and loss of appetite. However, in some cases, the infected person may not have any symptoms. Visual detection is the easiest way to identify threadworm infections. Threadworms appear as white cotton-like strands (about 5–13 mm long), and may be visible in stools or around the anus, especially at night or first thing in the morning. The ‘sticky tape test’ may help to identify threadworms and eggs.

Symptoms such as blood in stools or unexplained weight loss may indicate more serious worm infections, i.e. whipworm, roundworm or tapeworm. These infections are more common in patients who have travelled to developing countries or northern areas of Australia. Patients with suspect whipworm, roundworm or tapeworm infection should be referred to their doctor.

Several over-the-counter medicines can be used to treat threadworms; albendazole, mebendazole and pyrantel. These medicines do not kill threadworm eggs, and retreatment is required 2–3 weeks after the initial treatment course. Albendazole and mebendazole may be preferred in children <1 year, while pyrantel is the treatment of choice for pregnant and breastfeeding women. Children <6 months should be referred to their doctor for treatment.

Hygiene is particularly important when treating threadworms to reduce the risk of re-infection. Advise patients to avoid scratching the anal area then touching their mouth, and to wash hands thoroughly before eating or preparing food. Wash linen, bed clothes and towels in hot water, and the toilet seat disinfected. Furthermore, as threadworm infections are highly contagious, it is essential to treat all family members regardless of symptoms. The Threadworms PSA Self Care Fact Card provides valuable information for patients and carers.
Helminths infect billions of people each year, with a global disease burden greater than that of malaria or tuberculosis.1,2

The term helminth is derived from the Greek words ‘helmins’ or ‘helmithos’, and it defines a group of parasitic organisms that have a ‘worm-like’ anatomical appearance.1

Types of helminths

There are three major groups of helminths – flukes (trematodes), tapeworms (cestodes) and roundworms (nematodes).1,4 The most common cause of parasitic worm infection, worldwide, is nematodes (see Table 1).6

Learning objectives

After reading this article, pharmacists should be able to:

• Describe the various types of helminth infections
• Identify the signs and symptoms of a helminth infection
• Discuss appropriate treatment regimens for common helminth infections, including treatment options for special population groups
• Describe self-care measures that can be employed when treating common helminth infections
• Identify referral points when advising patients about the management of helminth infections.


Lifecycle, diagnosis, signs and symptoms

Pinworms (also known as threadworms)

Pinworm infection (caused by Enterobius vermicularis) is commonly referred to as threadworms in Australia, because they look like short pieces of white cotton (about 5–13 mm long) that move. However, it is important to note that the term human threadworm is also associated with the Strongyloides stercoralis species.6 Pinworm (threadworm) infection is the most common worm infection in Australia.7 Humans are the only host for the Enterobius vermicularis species of helminth.8 Threadworm eggs are colourless, sticky spheres that are visible to the naked eye when in clusters of thousands.9 The eggs are extremely resilient; they can survive for up to three weeks in a cool, moist environment.9

The threadworm egg can enter the body via inhalation or swallowing; the eggs can be directly deposited on the perianal folds.
Threadworms and other helminths

and the person can become self-infected through scratching the perianal area and then touching the mouth. The patient is at risk of ongoing re-infection if they itch the anus and transfer eggs to the mouth. Furthermore, transmission can occur from person-to-person through contaminated clothing, bed linen, or surfaces, and airborne eggs can be inhaled.

Eggs that are ingested or inhaled migrate to the small and large intestine (colon). In the small intestine the eggs hatch, and in the colon adult threadworms establish themselves. The adult threadworms attach to the small and large intestine (colon). Female adult threadworms live for approximately two months in the intestines. In the small intestine the eggs hatch, and in the large intestine (colon) the female adult threadworms attach.8 Female adult threadworms live for approximately two months in the intestines. When they are ready to lay eggs, the female worms migrate to the anus at night and lay eggs on the skin of the perineum. Female adult threadworms live for approximately two months in the intestines. When ready to lay eggs, the female worms migrate to the anus at night and lay eggs on the skin of the perineum.

Threadworm infections occur predominantly in school-aged children. Threadworm infections usually only cause minor signs and symptoms, and some cases are asymptomatic. In approximately 30% of cases patients experience pruritus ani (itch around the anus) especially at night. Other symptoms include abdominal symptoms (nausea, diarrhoea), irritability and sleeplessness (in children), loss of appetite, and insomnia.

In more severe infections, where a large number of eggs have been ingested, patients are more likely to experience acute diarrhoea, due to erosion and inflammation of the colonic mucosa. Adult female threadworms may be visible around the anal area, or may appear in the stools as small white threads. The most effective way to identify threadworms is to use the sticky tape test, where adhesive tape is applied to the anal area in the morning (before bathing) and then sent for microscopic examination at a laboratory.

In the majority of cases the detection of eggs on three separate days is usually diagnostic of threadworm infection. In addition, threadworms may also be visible in the stools (through movement) and around the anus, especially soon after falling asleep or first thing in the morning.

**Whipworm**

Whipworm infections caused by *Trichuris trichiura* are common in travellers and are highly prevalent in northern Aboriginal communities. Whipworm infection is more common in warm, humid environments, particularly where there are poor levels of sanitation and hygiene. It is more common in children, who are more likely to place foreign objects in their mouths. When a patient with whipworm defecates outside (in bushes or gardens) or the faeces of an infected patient are utilised in fertiliser, eggs are deposited into the soil, where they mature into an infective state. Whipworms are transmitted via the faecal-oral route, where hands or fingers that contain contaminated human faeces enter the mouth, mostly due to consumption of poorly washed or peeled vegetables grown in contaminated soil.

**Table 1. Most common helminth infections in Australia**

<table>
<thead>
<tr>
<th>Type of helminth</th>
<th>Species</th>
<th>Common name/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nematode</td>
<td>Enterobius vermicularis</td>
<td>Threadworms (also known as pinworms)</td>
</tr>
<tr>
<td>Nematode</td>
<td>Trichuris trichiura</td>
<td>Whipworm</td>
</tr>
<tr>
<td>Nematode</td>
<td>Ascaris lumbricoides</td>
<td>Roundworm</td>
</tr>
<tr>
<td>Nematode</td>
<td>Ancylostoma duodenale Necator americanus</td>
<td>Hookworm</td>
</tr>
<tr>
<td>Nematode</td>
<td>Strongyloides stercoralis</td>
<td>Human threadworm</td>
</tr>
<tr>
<td>Trematode</td>
<td>Taenia saginata</td>
<td>Beef tapeworm</td>
</tr>
<tr>
<td></td>
<td>Taenia solium</td>
<td>Pork tapeworm</td>
</tr>
</tbody>
</table>
Practice point 2

Treatment considerations for common helminth infections 6,14,23,27,28

Threadworms (pinworms)
Various anthelmintic agents can be used in the treatment of threadworm infection – albendazole, mebendazole and pyrantel. Treatment with such medicines may not always lead to death of immature worms in the small intestines, and does not cause the destruction of released eggs. As such, full eradication typically requires re-treatment with the chosen agent, 2 to 3 weeks following the initial treatment course.

Whipworm and human roundworm
Whipworm and roundworm can be treated with mebendazole or albendazole. Roundworm can also be treated with pyrantel. These treatments do not result in the death of migrating larvae, and as such, a follow-up examination (2 months after treatment) is usually required, to detect any parasites in the stool.

Hookworm
Hookworm infections are generally eradicated with a single dose of either albendazole, mebendazole or pyrantel. Repeat doses are often required to ensure the complete load of worms is eliminated from the body. Patients with significant anaemia may require iron supplementation.

Human threadworm
A single dose of ivermectin is the drug of choice for human threadworm infection. In addition, albendazole is also an effective treatment option. Immunocompromised patients should take a longer course of treatment for this condition. Following treatment, stool examination should be performed to assess for efficacy.

Tapeworm
Praziquantel and albendazole are indicated for the treatment of tapeworm infection. Praziquantel is the drug of choice; it is well absorbed and kills adult worms and larvae with a single dose.

Mixed intestinal worm infections
Albendazole is the treatment of choice over mebendazole, as it has a broader spectrum of activity and has superior absorption.

Table 2. Anthelmintics – summary of indications, dosage, precautions and adverse effects 23,25,26,29

<table>
<thead>
<tr>
<th>Anthelmintic</th>
<th>Indications</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benzimidazoles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albendazole (Zentel chewable tablets, Eskazole chewable tablets)</td>
<td>Roundworm</td>
<td>Roundworm, threadworm, hookworm:</td>
</tr>
<tr>
<td></td>
<td>Threadworm (pinworm)</td>
<td>• Adults, children above 6 months weighing more than 10 kg – 400 mg (single dose)</td>
</tr>
<tr>
<td></td>
<td>Hookworm</td>
<td>• Children above 6 months weighing less than 10 kg – 200 mg single dose (repeat dose after 2 weeks for threadworm)</td>
</tr>
<tr>
<td></td>
<td>Whipworm</td>
<td>Human threadworm (if ivermectin not suitable)</td>
</tr>
<tr>
<td></td>
<td>Human threadworm (if ivermectin not suitable)</td>
<td>Neurocysticercosis</td>
</tr>
<tr>
<td></td>
<td>Beef and pork tapeworm</td>
<td></td>
</tr>
<tr>
<td>Mebendazole (vermox chewable tablets, oral liquid, Deworm chewable tablets, Ridworm chewable tablets, Combantrin-1 with mebendazole chocolate squares, chewable tablets)</td>
<td>Threadworm (pinworm) Roundworm Hookworm Whipworm</td>
<td>Threadworm:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Adults, children weighing more than 10 kg – 100 mg single dose (can repeat in 2 weeks)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Children above 6 months weighing less than 10 kg – 50 mg single dose (can repeat in 2 weeks)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hookworm, roundworm, whipworm:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Adults, children weighing more than 10 kg – 12-hourly for 3 days (can repeat in 3 weeks)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Children above 6 months weighing less than 10 kg – 50 mg 12-hourly for 3 days (can repeat in 3 weeks)</td>
</tr>
<tr>
<td><strong>Other anthelmintics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ivermectin (Stromectol tablets)</td>
<td>Human threadworm (Strongyloides stercoralis)</td>
<td>Adults, children weighing more than 15 kg – 200 mcg/kg as a single dose (repeat dose either next day or 7–14 days later)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extended treatment in immunocompromised patients or severe cases</td>
</tr>
<tr>
<td>Praziquantel (Biltricide tablets)</td>
<td>Tapeworm</td>
<td>5–10 mg/kg as a single dose</td>
</tr>
<tr>
<td>Praziquantel (Anthel tablets, Combantrin oral liquid, chocolate squares)</td>
<td>Threadworm (pinworm) Roundworm Hookworm</td>
<td>Threadworm, roundworm:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Adults and children – 10 mg/kg (maximum 1 g) single dose (for threadworm, repeat dose after 2 weeks or 1 week for heavy roundworm infection)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hookworm:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Adults and children – 10 mg/kg (maximum 1 g) daily for 3 days</td>
</tr>
</tbody>
</table>

Note: Anthelmintics will work to kill and eliminate worms which have invaded the host. However, they will not effectively kill eggs that have been laid around the anal area. Worm eggs can survive outside the body for various timeframes, and as such, hygiene measures following treatment are essential, to ensure eggs are removed from the body surfaces and to prevent further spread and re-infection of the individual (and those in close contact, such as family members).
<table>
<thead>
<tr>
<th>Precautions</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ocular cysticercosis – may cause severe eye damage</td>
<td>Generally well tolerated</td>
</tr>
<tr>
<td>• Reduce dose and consider extended treatment duration in hepatic impairment</td>
<td>Common – headache, nausea, vomiting and diarrhoea, dizziness, fever, elevated liver function tests</td>
</tr>
<tr>
<td>• Avoid use in pregnancy (teratogenic) – Category D</td>
<td>Rare – hypersensitivity (urticaria), alopecia, hepatitis, depression of bone marrow, cholestatic jaundice, Stevens-Johnson syndrome</td>
</tr>
<tr>
<td>• Appears to be safe in breastfeeding – low systemic concentrations in the mother</td>
<td>Note: when treating neurocysticercosis can result in neurological symptoms (fever, worsening of disease, headache).</td>
</tr>
<tr>
<td>• Women – ensure use of effective contraception during and for one month after treatment</td>
<td></td>
</tr>
<tr>
<td>• Not for use in children below 6 months</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practice point 3</th>
</tr>
</thead>
</table>

**Tips to prevent spread and re-infection**

- Wash hands thoroughly (with soap and water) especially before eating or preparing food, after going to the toilet, changing nappies or looking after infected children.
- Avoid scratching of the anal area and avoid nail biting or touching the mouth with the hands. Fingernails should be scrubbed and kept short in length to prevent spreading infection.
- Shower the night the medication is taken and again the following morning, to wash away any eggs that may be laid overnight. Sheets, bed linen, underwear, nightwear and towels should be washed in hot water (to kill eggs) and patients should avoid shaking bed linen indoors to prevent the spread of eggs around the house. The toilet seat should be thoroughly cleaned with disinfectant.
- Use of a protective ointment on the anal area at night.
- Wearing firm underwear or mittens to reduce scratching.
- Children do not need to be kept home from school or childcare once they have been treated.
- Household pets do not need to be treated, and patients should be assured that they are not the cause of their infection, as humans are the sole host for threadworm (pinworm) infections.

**Precautions**

- Avoid use during first trimester pregnancy – Category B3
- Suitable for use during breastfeeding – not well absorbed by mother
- Not for use in children below 6 months

**Adverse effects**

- Generally well tolerated
- Common – headache, nausea, vomiting and diarrhoea, dizziness, fever, abdominal pain, elevated liver function tests
- Rare – hypersensitivity (urticaria), alopecia, hepatitis, depression of bone marrow, cholestatic jaundice, Stevens-Johnson syndrome

**Practice point 3**

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**Precautions**

- Avoid use in pregnancy – Category B3
- Suitable for use in breastfeeding
- Not for use in children below 3 years and/or weighing less than 15 kg

**Adverse effects**

- Common – diarrhoea, nausea, dizziness
- Infrequent – fatigue, abdominal discomfort, constipation, tremor, rash, somnolence

**Practice point 3**

**Tips to prevent spread and re-infection**

- Wash hands thoroughly (with soap and water) especially before eating or preparing food, after going to the toilet, changing nappies or looking after infected children.
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**Practice point 3**

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**Precautions**

- Avoid use in pregnancy – Category B3
- Suitable for use in breastfeeding
- Not for use in children below 3 years and/or weighing less than 15 kg

**Adverse effects**

- Common – diarrhoea, nausea, dizziness
- Infrequent – fatigue, abdominal discomfort, constipation, tremor, rash, somnolence
Infection with whipworms is usually asymptomatic. More severe infections can lead to growth retardation, anaemia in children and impaired cognitive development. In extremely heavy infections, patients can experience severe diarrhoea, that contains mucous and blood. Whipworm is diagnosed via faecal microscopy.

Roundworm

Ascaris lumbricoides is the infective species responsible for human roundworm infection. Roundworms (which can be up to 30 cm in length) cause an intestinal infection and are fairly common in temperate and tropical parts of the world, including Australia. Similar to whipworms, infection with roundworm is more prevalent in communities with poor sanitary conditions. Roundworm is acquired through the ingestion of worms, typically via food or water that are contaminated with infected faeces, or via uncooked produce that contains soil contaminated with eggs. Transmission does not typically occur from person-to-person contact or through fresh faeces. Roundworm eggs can survive for months to years in contaminated soil. Once ingested, the eggs hatch in the small intestine and then pass through the intestinal wall into the bloodstream. The parasites then travel to the heart, liver and lungs and finally, migrate up the pharynx where they are swallowed and passed to the small intestine, approximately 2 to 3 weeks after initial ingestion. In the small intestine the parasites mature to the adult form and mate, and the female worm lays eggs within 2 months of ingestion. The female worm can survive between 12–24 months in the small intestine, and the infection is communicable for the extent of the worm’s lifecycle.

This condition is usually asymptomatic until the adult worm emerges via the anus, nose or mouth. Patients may experience some abdominal symptoms, and in severe cases, may be at risk of intestinal obstruction or biliary disease. Due to the migration path of the parasite (through the heart, liver and lungs) patients may experience conditions such as pneumonitis, liver damage or allergy.

Hookworm

Hookworm infections occur more commonly in humid and tropical regions of the world, and are an extremely common health condition in poverty-stricken patients. Various species of hookworm exist, however, Ancylostoma duodenale and Necator americanus are the most common causes of hookworm infections in humans. Infection with hookworm typically occurs following contact with contaminated, damp soil (i.e. walking barefoot), through which larvae invade the skin (even through clothing). At the point of contamination, patients often report symptoms such as pruritus and a transient rash in the affected area. Alternatively infection can occur by ingesting hookworm eggs.

Most cases are asymptomatic, however, adult hookworms attach to the mucosa of the small intestine, resulting in abdominal symptoms such as diarrhoea. In severe cases (due to heavy exposure to infective parasites), patients may experience mild respiratory symptoms and epigastric discomfort, even before eggs appear in faeces. Severe cases can also result in anaemia and protein deficiencies due to blood loss at the site of intestinal attachment.

Human threadworm

Human threadworm infection is caused by the Strongyloides stercoralis species. This is predominantly present in rural areas with poor levels of sanitation where faecal soil contamination occurs. When the human

<table>
<thead>
<tr>
<th>Antihelmintic</th>
<th>Use in pregnancy</th>
<th>Use in breastfeeding</th>
<th>Use in children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albendazole</td>
<td>Category D – cannot be used due to teratogenicity</td>
<td>Appears to be safe – low systemic concentrations in mother</td>
<td>Suitable for children aged over 6 months</td>
</tr>
<tr>
<td>Mebendazole</td>
<td>Category B3 – avoid during first trimester</td>
<td>Suitable for use – low absorption by mother</td>
<td>Suitable for children aged over 6 months</td>
</tr>
<tr>
<td>Ivermectin</td>
<td>Category B3 – avoid use</td>
<td>Suitable for use</td>
<td>Suitable for children aged over 5 years and/or weighing over 15 kg</td>
</tr>
<tr>
<td>Praziquantel</td>
<td>Category B1 – appears to be suitable</td>
<td>Suitable for use – little excretion in breast milk</td>
<td>Suitable for children over 1 year</td>
</tr>
<tr>
<td>Pyrantel</td>
<td>Category B2 – appears to be suitable</td>
<td>Suitable for use</td>
<td>Suitable for children over 1 year</td>
</tr>
</tbody>
</table>
host walks barefoot on contaminated soil, the larvae penetrate the skin into the venous system and migrate to the lungs, move to the pharynx and finally, are swallowed.19 Once the larvae reach the small intestines they become adult female worms and reproduce asexually.19 Strongyloidiasis can also be transmitted sexually through oro-anal contact. This is most commonly seen in men who have sex with men.19

As with many other helminth infections, human threadworm infection can often be asymptomatic.19 However, common symptoms of human threadworm include pruritus at the point of entry (commonly the foot), recurrent abdominal pain, vomiting, diarrhoea, weight loss and blood eosinophilia.6,19 Threadworm larvae can also migrate to the lungs, resulting in symptoms of dry cough or wheeze.19 Infection with Strongyloides stercoralis can persist for long periods of time, in some cases indefinitely.6 Patients who are chronically infected with this parasite can become immunosuppressed, which is more likely in patients taking immunosuppressants. This leads to uncontrolled larvae over-proliferation and migration to the lungs, liver and brain – known as a state of hyper-infection.6,19 This condition can be accelerated if the patient is taking corticosteroids, which appear to stimulate the female worms to hatch and develop at a more rapid rate.6 Human threadworm infection is usually diagnosed via duodenal biopsy, as it can be difficult to detect the larvae in faeces.6

Tapeworm

Tapeworm infections are more prevalent in developing countries, and occasionally occur in Australia in travellers returning from these regions.6,20 Beef and pork tapeworms are the most common types of tapeworm infection, and are caused by Taenia saginata and Taenia solium.6 Cattle or pigs become infected with tapeworms through the ingestion of contaminated human faeces; tapeworms invade the animal flesh leading to the development of cysticerci (cysts).5 Tapeworms invade the human body through medical imaging.19,22 Cysticerci are then ingested by humans through the consumption of inadequately cooked beef or pork that is contaminated with cysts, leading to the development of large tapeworms in the human gut (10 to 15 feet in length).14 This results in cysticercosis – the invasion of larvae into human tissue.14 In extreme cases of this condition, larvae can enter the central nervous system, resulting in neurocysticercosis.14

Figure 1. Threadworm life cycle

Once again, infection with this helminth is typically asymptomatic, however some patients may experience abdominal discomfort, diarrhoea and a reduction in appetite.22 Neurocysticercosis can lead to symptoms such as headache, seizures and confusion.22 Infection with tapeworm is diagnosed through a blood test, the discovery of worm segments in a stool sample, or the identification of cysts in the body through medical imaging.19,22

Treatment options

There are various anthelmintics which can be used in the treatment of parasitic worm infections. See Table 2, Table 3 and Practice point 2.

The benzimidazole class of anthelmintics includes albendazole and mebendazole.23 These medicines inhibit beta-tubulin polymerisation, resulting in the inhibition of both glucose uptake in the parasite and cytoplasmic microtubule formation.23,24 The end result is immobilisation and subsequent death of adult worms, and prevention of egg hatching.24 When taken for hookworm, roundworm, threadworm (pinworm), human threadworm, tapeworm and whipworm, albendazole is best taken on an empty stomach in order to minimise intestinal absorption.23 When taken for neurocysticercosis (a systemic infection), albendazole should be taken with food, to increase absorption.23 Ivermectin also causes parasitic death, by blocking transmission across nerve synapses which utilise glutamate-gated chloride ion channels or GABA gated chloride channels.22,24 The result is prevention of nerve impulse conduction, leading to paralysis and death.24 Praziquantel has a potential two-fold action – at lower doses, it causes increased muscular activity, leading to in worm paralysis and detachment from the host tissue; at higher doses, it causes worm destruction due to the activation of host defences.23 Praziquantel is best taken with food and sufficient water (tablets can be cut but cannot be chewed) as the bitter-tasting compound can induce reflex gagging.23 Pyrantel blocks parasitic neuromuscular function, leading to paralysis and detachment (and subsequent expulsion) of worms from the gastrointestinal tract.23,24

Self care and preventive measures

Threadworms (pinworms)

When treating threadworm infection, there are a number of self care and preventive measures that can both increase
treatment success, and avoid the spread of infection to family or household members. Regardless of the presence of symptoms, it is essential that everyone is treated with an anthelmintic agent to ensure eradication.1,2,4,7,12,14,21 The risk of transmission within families is particularly high, occurring in approximately 75% of cases.16 Personal hygiene is paramount in the prevention of re-infection with the threadworm parasite, due to the potential for ongoing self-re-infection through scratching the anal area and then touching the mouth (see Practice point 3).5 Such measures should be employed for 2 to 6 weeks.10 Depending on the medicine used for treating threadworm, it should be repeated, as recommended, in due course as this allows for eradication of eggs or worms that may have survived the first treatment course.11

Whipworm and human roundworm

These soil-transmitted helminths are more common in areas with poor levels of sanitation and hygiene. When travelling to such areas, patients should ensure they adequately wash their hands (with soap and water) following bowel movements or nappy changes, and that vegetables (and uncooked produce) are washed well prior to consumption.

Hookworm and human threadworm

Once again, these infections are more likely in areas with poor sanitation. As the primary mode of transmission, is via walking/skin contact with contaminated soil, patients should ensure they wear footwear when travelling to developing countries where the risk is higher.

Tapeworm

Beef and pork tapeworm are transmitted via the consumption of undercooked beef and pork in developing countries. People should ensure all beef and pork consumed and is well cooked.

Case study

Marisa comes to your pharmacy today for some advice. She is quite certain that her 3-year-old daughter, Molly, has worms. Molly has been complaining of an itchy bottom for the past week or so; it is extremely itchy at night. As a result Molly is not sleeping very well and of late has been feeling increasingly irritable. Marisa also notes that Molly has not been eating as much as usual in the past week, as she does not seem to be hungry. Marisa checked Molly’s bottom last night after she fell asleep, and is certain she saw some movement of worms. She is particularly concerned about catching the worms as she is pregnant (second trimester) and does not want to take medicine that might affect her unborn baby. Marisa is a single mother, who lives alone with her 3-year-old daughter at present.

You advise Marisa that Molly appears to be experiencing common signs and symptoms of threadworm (or pinworm) infection. This is the most common worm infection in Australia, and occurs more frequently in children. You inform Marisa that threadworm infection is treated with medicines which kill the worms. In this case, for Molly, you recommend Combantrin (pyrantel) 50 mg/mL oral liquid (15mL bottle). Molly weighs 13 kg so her dose would be 130 mg, i.e. 2.6 mL as a single dose. You advise Marisa that Combantrin is suitable for use in children of Molly’s age and explain that all family members need to be treated, even if they do not have symptoms, as the chance of cross infection is high. You inform Marisa that there are some suitable treatment options that can be used during pregnancy. In this case, the medicine that you have recommended for Molly is also suitable for Marisa (pyrantel is Category B2 in pregnancy). Marisa weighs 60 kg so her dose would be 600 mg, i.e. 12 mL as a single dose.

You advise Marisa that she and Molly will require a second treatment course (of the same medicine and dosage) in 2 weeks, as the first treatment does not always kill immature worms or eggs which have already been laid. In addition, you advise Marisa to implement the following self-care and preventive measures for the next 2 to 6 weeks, to reduce the chances of re-infection:

- Washing of hands well with soap and water, especially before eating/preparing food and after going to the toilet.
- Avoid scratching the anal area (important to encourage Molly not to scratch her itchy bottom, or bite her nails). Eggs are laid in the anal area, and if they get caught under fingernails, and then the hands placed in the mouth, this can cause re-infection.
- Scrub the fingernails well and keep them cut short.
- Shower tonight (after having taken the medicine) and again tomorrow morning, to wash away any eggs that are laid overnight – repeat with the second treatment course in 2 weeks.

- Wash bed linen, underwear, nightwear and towels to kill the eggs – avoid shaking bed linen inside to reduce the spread of eggs in the house.
- Clean the toilet seat with disinfectant.
- Consider the use of mittens and firm underwear at night, to reduce scratching.

References

1. Lamb T. Immunity to parasitic infection. West Sussex, UK: John Wiley and Sons;2012.
Circle one correct answer from each of the following questions.

Before undertaking this assessment, you need to have read the Facts Behind the Fact Card article and the associated Fact Cards. This activity has been accredited by PSA as a Group 2 activity. Two CPD credits (Group 2) will be awarded to pharmacists with four out of five questions correct. PSA is accredited by the Australian Pharmacy Council to accredit providers of CPD activities for pharmacists that may be used as supporting evidence of continuing competence.

Assessment due 31 October 2014
Submit answers
Submit online at www.psa.org.au/selfcare
Fax: 02 6285 2869
Mail: Self Care Answers
Pharmaceutical Society of Australia
PO Box 42
DEAKIN WEST ACT 2600

Accreditation number: CS140008
This activity has been accredited for 1 hour Group 2 CPD (or 2 CPD credits) suitable for inclusion in an individual pharmacist’s CPD plan.

Please retain a copy for your own purposes. Photocopy if you require extra copies.

1. Anaemia can be caused by which ONE of the following helminth infections:
   a) Tapeworms.
   b) Threadworms (pinworms).
   c) Roundworms.
   d) Hookworms.

2. John would like some medicine for worms, as he has the signs and symptoms of threadworm (pinworm) infection. He is an 80 kg male, who lives with his wife, Bridget (55 kg), and their 7-month-old baby daughter Kelly (7.5 kg). What quantity of mebendazole chocolate squares (100 mg/square) will be sufficient to treat his family for this treatment, and the repeat treatment course in 2 weeks?
   a) 5 squares – 2 for John, 2 for Bridget and 1 for Kelly.
   b) 4 squares – 1.5 for John, 1.5 for Bridget and 1 for Kelly.
   c) 3 squares – 1 for each family member.
   d) 2.5 squares – 1 for John, 1 for Bridget and 0.5 for Kelly.

3. When recommending worm treatments in pregnancy, which ONE of the following is Category D (teratogenic)?
   a) Mebendazole.
   b) Ivermectin.
   c) Albendazole.
   d) Pyrantel.

4. Choose the ONE correct option. When advising patients on preventive measures for threadworm:
   a) All household pets must be taken to the vet for worm treatment, as threadworms can survive in humans and animals (such as cats and dogs).
   b) Children with worms must stay home from school or childcare for 6 days after the treatment course, to prevent spread of infection.
   c) Patients should avoid showering the night after treatment.
   d) Use of a protective ointment on the anal area can help to control itch at night.

5. Choose the ONE correct option. Tapeworm:
   a) can be treated with praziquantel as a single dose.
   b) is usually transmitted via walking barefoot on contaminated soil.
   c) is the most common worm infection in Australia.
   d) is usually diagnosed by duodenal biopsy.
Threadworms are a common infection in Australia – it is important as pharmacy assistants to know common signs and symptoms, treatment options and when to refer to the pharmacist.

Threadworms (pinworms)

What are threadworms?
Threadworms are the most common type of worm infection in Australia. They most commonly affect school-aged children. Threadworms are sometimes referred to as pinworms. A person becomes infected with threadworms when they swallow or inhale the worm's eggs. Once the eggs enter the body, they move to the intestines where they hatch and develop into full-grown adult threadworms (only the female worms survive). Female adult worms live for approximately 2 months in the intestines and after this time, they move to the bottom at night (usually while the person is sleeping), and lay eggs around the anal area. Each female worm lays eggs only once, releasing approximately 10 to 15 thousand eggs before they die.

Types of worms

There are three major groups of worms:
- flukes (also called trematodes)
- tapeworms (also called cestodes)
- roundworms (also called nematodes).

Within each of these groups there are many different species of worms which can cause infection. Table 1 summarises the major species of worms that cause infections, with their common names. In Australia, the most common type of worm infection is threadworms. Other worm infections mainly occur in countries overseas, and people are at risk of infection when they travel to these countries.
How do threadworm infections spread?

Threadworm infections spread when eggs are swallowed or inhaled from a contaminated environment. Also when an infected patient scratches their bottom, they can pick up eggs under their fingernails and if they then place their fingers in their mouth, they can be at risk of re-infection. This is the common reason why children are more likely to become infected with threadworms. Threadworm eggs can also transfer onto clothing, bedding, linen, toys, furniture or floors (especially around the toilet) and this can lead to the infection of other people in the household, if they come into contact with these eggs. Threadworm eggs can survive outside the body for 2–3 weeks, making the chance of re-infection in the household very high.

It is important to note that humans are the only host for threadworms; they cannot survive in animals. For this reason, it is not possible to catch threadworms from animals or pets. However, other types of worms (e.g. tapeworm) can sometimes transfer from animals to humans.

What are the sign and symptoms of a threadworm infection?

Threadworm eggs in the anal area can sometimes cause an itchy bottom (especially at night), however this does not occur in all cases. The itch can be caused by ‘glue’ that attaches eggs to the anal area. Other symptoms of threadworm infections include:

- itch around the vaginal area
- nausea
- diarrhoea
- irritability
- restless children
- trouble sleeping/disturbed sleep
- loss of appetite
- stomach pain
- generally feeling unwell.

Threadworm infections usually only cause these minor signs and symptoms, and do not cause major health problems.

How to find threadworms?

Parents or caregivers may see the threadworms around the anal area – they look like small, white threads of cotton. Threadworms are very small; only about 5–10 mm in length. Worms are most active at night (when the person is relaxed), and may be more visible once the child is asleep, or first thing in the morning. Sometimes, worms can be seen moving in bowel motions. The best way to find threadworms is to place some sticky tape over the anus in the morning (before bathing). Any eggs that have been laid will stick to the tape. Speak to the doctor about having the tape examined by a microscope to confirm a threadworm infection.

Principles of treatment

Threadworm infection is extremely contagious, and can easily be passed on to others in the household. When treating threadworm infections, it is important that all family/household members are treated, even if they do not have any signs and symptoms of infection. The medicine should be given to all members of the household at the same time. After treatment, the bottom may still feel itchy for a few days due to the irritation caused by the worms, eggs and ‘glue’ – this does not mean the treatment has not worked. However, it is important to note that the medicines do not always kill all of the worms on the first treatment course. This is why the patient often requires re-treatment with the same medicine after 2 weeks, to make sure all the worms have been removed from the body.

Advise the patient to take a shower on the night of taking the medicine and also the next morning so any eggs laid during the night are washed away. The use of a protective ointment around the anus at night may help to reduce the itch and scratching.

When to refer to the pharmacist?

There are a number of times when you should refer patients with suspected threadworm infection to the pharmacist:

- When a parent requests treatment for a child below the age of two years.
- If any member of the family is pregnant or breastfeeding.
- Threadworm medication has been used but was not successful.
- There is broken skin around the anal area due to scratching; this may develop into an infection.
- When the patient or family has been travelling overseas, or to northern Australia – different types of worm infections may occur in these areas.
- Any of the following symptoms are present: blood in bowel motions, stomach pain, nausea, diarrhoea or vomiting, unexplained weight loss.

How to prevent spread?

Strict personal hygiene is extremely important in preventing the spread of threadworm infections. As children are most commonly affected by this condition, it is important to discourage children from scratching their bottoms, then touching the mouth, to avoid re-infection. Keep the fingernails short and scrub them well,

### Table 1. Major species causing common worm infections

<table>
<thead>
<tr>
<th>Group of worms</th>
<th>Species</th>
<th>Common name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nematode</td>
<td>Enterobius vermicularis</td>
<td>Threadworms (also known as pinworms)</td>
</tr>
<tr>
<td>Nematode</td>
<td>Trichuris trichiura</td>
<td>Whipworm</td>
</tr>
<tr>
<td>Nematode</td>
<td>Ascaris lumbricoides</td>
<td>Roundworm</td>
</tr>
<tr>
<td>Nematode</td>
<td>Ancylostoma duodenale</td>
<td>Hookworm</td>
</tr>
<tr>
<td>Nematode</td>
<td>Necator americanus</td>
<td></td>
</tr>
<tr>
<td>Nematode</td>
<td>Strongyloides stercoralis</td>
<td>Human threadworm</td>
</tr>
<tr>
<td>Trematode</td>
<td>Taenia saginata (beef)</td>
<td>Tapeworm</td>
</tr>
<tr>
<td></td>
<td>Taenia solium (pork)</td>
<td></td>
</tr>
</tbody>
</table>
to reduce the chance of eggs being lodged under the nails. Children can wear mittens at bedtime, and firm underwear, to help reduce the chance of scratching overnight. Family and household members should make sure they wash their hands with soap and water, especially before eating meals or preparing food, and after going to the toilet or changing nappies.

Clothing, such as underwear, nightwear, bed linen, and towels, should be washed in hot water to kill any eggs. Bed linen should be shaken outside to prevent spreading eggs around the house. Clean the toilet seat, floors around the toilet and bathroom with a strong disinfectant. Dusting the house and vacuuming (especially under mattresses) can also help to remove eggs from the household. Once treated with medicine, children do not need to stay home from school or childcare. It is also important to advise patients that threadworms only survive in humans, not animals. As such, they do not need to treat household animals with worming medicines, as they cannot catch or transmit the threadworm infection to humans. Animals can pass other types of worm infections to humans but this does not occur very commonly in Australia. You also discover that Cynthia and her family have not been travelling for the past 2 years, and no one in the family is experiencing any signs and symptoms of threadworm infection at the moment. You explain to Cynthia that medicines which treat threadworms do not prevent infection, so there is no point treating the family with this medicine when they do not appear to be experiencing any signs and symptoms of threadworm infection.

Case study

Cynthia comes to the pharmacy today for your advice. This morning she found worms in her 7-month-old puppy’s bowel motions. She saw live worms moving in the bowel motions and she is very upset. Cynthia went to the vet and had her puppy treated immediately. However, she is now worried that the worms might spread to the rest of the family so she wants some medicines to prevent the infection.

You explain to Cynthia that the most common worm infection in Australia is threadworms. Threadworms only survive in humans, not animals (such as her dog) so there is no chance that her dog could pass a threadworm infection to the rest of the family. Animals can pass other types of worm infections to humans but this does not occur very commonly in Australia. You also discover that Cynthia and her family have not been travelling for the past 2 years, and no one in the family is experiencing any signs and symptoms of threadworm infection at the moment. You explain to Cynthia that medicines which treat threadworms do not prevent infection, so there is no point treating the family with this medicine when they do not appear to be experiencing any signs and symptoms of threadworm infection.

You provide Cynthia with a Threadworms PSA Self Care Fact Card and offer her the opportunity to speak with the pharmacist if she needs any more information.

Table 2. Over-the-counter medicines used to treat threadworms

<table>
<thead>
<tr>
<th>Name of medicine</th>
<th>Common brand names</th>
<th>How the medicine works</th>
<th>Dose</th>
<th>Use in children?</th>
<th>Side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mebendazole</td>
<td>Vermox chewable tablets or oral liquid, DeWorm chewable tablets, Ridworm chewable tablets, Combantrin-1 with mebendazole chocolate squares or chewable tablets</td>
<td>Kills adult worms in the intestines and also prevents any laid eggs from hatching in the anal area.</td>
<td>Adults, children weighing more than 10 kg – 100 mg single dose (can repeat in 2 weeks) Children above 6 months weighing less than 10 kg – 50 mg single dose (can repeat in 2 weeks)</td>
<td>Can be used to treat threadworm infection in children Refer to the pharmacist if child is &lt;2 years</td>
<td>Usually well tolerated May cause stomach pain, diarrhoea or vomiting, headache and dizziness</td>
</tr>
<tr>
<td>Pyrantel</td>
<td>Anthel tablets, Combantrin oral liquid or chocolate squares</td>
<td>Pyrantel paralyses the worms, causing them to die and be ejected from the body.</td>
<td>Adults and children – 10 mg/kg (maximum 1 g) single dose (for threadworm, repeat dose after 2 weeks)</td>
<td>Can be used to treat threadworm infection in children Refer to the pharmacist if child is &lt;2 years</td>
<td>May cause stomach pain, diarrhoea or vomiting and headache</td>
</tr>
</tbody>
</table>

Figure 1. Thread worm life cycle.
Assessment questions for the pharmacy assistant

Threadworms and other helminths

Circle one correct answer from each of the following questions.

Before undertaking this assessment, you need to have read the Counter Connection article and the associated Fact Cards.

The pass mark for each module is five correct answers. Participants receive one credit for each successfully completed module. On completion of 10 correct modules participants receive an Achievement Certificate.

Assessment due 31 October 2014

Please retain a copy for your own purposes. Photocopy if you require extra copies.

Submit answers
Submit online at www.psa.org.au/selfcare
Fax: 02 6285 2869
Mail: Self Care Answers
Pharmaceutical Society of Australia
PO Box 42
DEAKIN WEST ACT 2600

1. The most common worm infection in Australia is:
   a) Threadworms.
   b) Hookworms.
   c) Roundworms.
   d) Tapeworms.

2. Threadworm infections:
   a) can be spread through swallowing or inhaling threadworm eggs.
   b) can pass from a dog or cat to a human.
   c) are not very contagious.
   d) cannot be treated with over-the-counter medicines.

3. Signs and symptoms of a threadworm infection include:
   a) Severe vomiting.
   b) Dizziness.
   c) Itch around the bottom or vagina.
   d) Headaches.

4. Mebendazole:
   a) is not generally well tolerated.
   b) can be given as a single dose, and no repeat treatment is needed in 2 weeks.
   c) paralyses worms causing them to die.
   d) can be used in children over the age of 2 years.

5. Pyrantel:
   a) can sometimes cause stomach pain, diarrhoea or vomiting.
   b) is only available with a prescription.
   c) prevents the laid eggs from hatching.
   d) requires a repeat treatment course in 6 weeks.

6. When preventing spread of threadworm infection:
   a) Shake bed linen well in the house to remove eggs.
   b) Wash bed linen and nightwear in hot water to kill eggs.
   c) Keep children home from school for 24 hours after the first treatment course.
   d) Treat all animals with appropriate worming medicines.
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Self Care presents certificates to staff who successfully complete a year of Counter Connection modules. We would like to congratulate the following people: