

## PedsCases Podcast Scripts

This is a text version of a podcast from PedsCases.com on “**Lice and Scabies.**” These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at [www.pedscases.com/podcasts](http://www.pedscases.com/podcasts).

### Lice and Scabies

Developed by Caleb Botta and Dr. Julie Martin for PedsCases.com.  
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#### Introduction

Hello, my name is Caleb Botta and welcome to PedsCases. I am a senior medical student from the Medical College of Georgia. I want to thank Dr. Julie Martin for her time in helping me create this podcast. Today I will discuss the presentation and treatment of two common parasites: lice and scabies.

By the end of the podcast the learner will be able to:

1. Identify common clinical manifestations of lice and scabies infestations.
2. Apply available diagnostic methods to confirm the diagnosis.
3. List the first line treatments for lice and scabies
4. Develop an approach to the broader clinical context for when to choose which treatment strategy.

#### Case Introduction

**Let's start with a case.** Sam is a nine-year-old boy who presents the last week of September for a well child visit. His only complaint is that his head has been itching for the past few days. Sam's mom remembers that she received a letter after the first week of school saying someone in Sam's class had been treated for lice, but after looking at his hair she has not seen any insects. They have tried using a permethrin shampoo that she bought over the counter, but it has not helped despite two uses seven days apart. On physical exam, inspection of Sam's scalp reveals several areas of excoriated skin where Sam has been scratching.

**What is the best next step in Sam's care?** Let's learn together about lice and then see if we can use what we have learned to figure out how to best take care of Sam.

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## Introduction to the Human Louse – Key Takeaways

Lice are obligate ectoparasites. There are three different species of lice that infest humans. They are head lice, body lice, and pubic lice, also known as crab lice (1). I am going to start by giving you an overview of what you need to know in order to take care of patients with each type of lice. Then we will dive further into the topic of head lice since head lice are what you are most likely to see in children.

- Head lice
  - o Head lice is the most common type of lice in school-age children (2–4)
  - o They are not associated with poor hygiene (5–7)
  - o The louse eggshells, or nits (8), are found exclusively on the scalp (9). Key areas to look include both temples, behind the ears, and at the base at the neck (10).
  - o Patterns of treatment resistance have been seen worldwide (3)
- Body lice
  - o Body lice are vectors of human disease: *Rickettsia prowazekii* (epidemic typhus), *Bartonella quintana* (trench fever), *Borrelia recurrentis* (epidemic relapsing fever)(11)
  - o Fomite management is key (12)
    - Nits found in clothing seams, bedding (12)
- Crab lice
  - o Not just the pubic area: beards, eyelashes, axilla (2,13)
  - o Maculae ceruleae are blue or slate colored lesions in patients with heavy crab lice infestations. They are typically on found chest, abdomen, and thighs (14)
  - o Patients with crab lice should be screened for other sexually transmitted infections (2)

**Sound good? Let's jump into the details.**

### Lice Background and Clinical Manifestations (LO#1)

First, it is important to know that each of these types of lice only infest humans (1). Therefore, treatments of family pets are not necessary (1,6,8,15). Lice are small insects that crawl but do not jump or fly (16). They get their energy from ingesting human blood. Each bite has an injection of anesthetic and anticoagulant along with other antigens (1). The characteristic itching associated with lice infestations occurs 3-4 weeks later and is an allergic reaction to these antigens (1). That being said, only 14-36% of patients experience itching (7). Those who have had lice previously may begin to itch in just two days (7).

Lice cannot survive apart from a human host, but how long they can survive depends on the type of louse and environmental factors. Head lice typically cannot survive more than one day at room temperature, and pubic lice can last about 48 hours (5,14). Body lice, in contrast, can survive for 5-7 days. They thrive in humid, cooler environments that prevent desiccation (11).

**Head lice are what comes to mind when many people think of lice.** They are associated with school-age children, and outbreaks often occur once children return to school after summer vacation (7). It is estimated that 6-12 million children ages 3-12 years old are infested annually in the United States (13). Thankfully, head lice are not thought to be vectors of human disease.

Transmission of head lice occurs primarily via head to head contact. Giving another person lice through an object, called a “fomite”, such as a pillow, hat, or hairbrush typically does not occur (7). Hair lice nits are cemented firmly to the hair shaft by an adhesive at the scalp, and the height of a nit on the hair shaft can be used to approximate the amount of time it has been there. Hair grows roughly 1cm per month. Any nits found more than 1cm from the scalp should, therefore, be considered nonviable and not thought of as evidence of active infestation. In fact, empty egg sacs can persist for months after the clearing of a lice infestation (5).

### **Diagnostic Methods (LO#2)**

**Diagnosis is typically made by finding a louse or nit in a patient’s hair.** Lice can move quickly and will try to avoid light (17). This, coupled with the fact that many patients do not experience the itching allergic reaction, can make the diagnosis difficult to make. An active infestation is defined as finding live lice in a patient’s hair or finding a nit on a hair shaft within 1cm of the scalp. Visual inspection of the patient’s hair to detect active infestation has a low sensitivity of only 29% (18). This can be improved to 91% by the use of the wet combing method, where the patient’s hair is washed with a conditioner to slow down the lice and then combed with a fine-toothed comb. Key areas to check are both temples, behind the ears, and at the base at the neck (10). Removing lice in this way also has a beneficial therapeutic advantage (13). It is important to teach parents to use the wet combing method in order to screen the patient’s other family members for lice. That being said, visual examination is 86% sensitive for the detection of nits indicating historical infestation, and it is reasonable to do this for this purpose. A Wood’s lamp will cause head lice to fluoresce a pale blue (19), and this can be helpful.

If you think that you have found evidence of lice in a child’s hair, it is important to confirm that what you have found is not actually something else. One study found that 35% of specimens thought to be lice or nits sent to a reference center were actually dandruff. A key difference is that a nit will be firmly fixed to the hair shaft (10,15). Light microscopy providing extra magnification can also be extremely helpful. Lice have six legs, are tan to grayish-white in color, and are about the size of a sesame seed (20).

### **Case Continuation**

**Back to our case:** If you remember, his head has been itching but his Mom hasn’t seen any bugs in his hair. It is important to ask when Mom treated him with the permethrin. It is reasonable to expect the itching to continue for a little while even with successful treatment. The lice may also have survived the treatment, or there could be a completely different reason for his itching. **Using what you have just learned, what do you think is the best next step to take care of Sam?**

Good job!

You look around his temples and behind his ears but do not see anything out of the ordinary. Next, you examine the base of Sam's neck, and you get lucky! You manage to catch a louse just about to scurry out of sight. You place the louse on a microscope slide and confirm that it is, in fact, a louse and not a piece of dandruff or a different insect. With further inspection, you also find several nits located at the nape of his neck and behind his ears. The nits are firmly attached to the hair shafts and are less than 1cm from the scalp, indicating an active infestation.

**What treatment options are available for Sam? In addition to his individual treatment, what further steps should be undertaken to prevent recurrence and further spread into the community?** We already mentioned that Mom has already tried a permethrin shampoo and that it didn't work very well. Let's discuss the different options available to treat lice and then decide what to give Sam.

### **Treatment LO(#3)**

**Treatment begins with the initial management of symptoms.** Antihistamines and topical steroids can be used to help alleviate any itching or burning caused by the lice or by the topical treatments that are given (16).

Eradication of lice can be somewhat complicated due to rising resistance to traditional first-line agents. First line is the **neurotoxic agent permethrin** and the pyrethrins which are chemically similar. The Canadian Pediatric Society recommends two permethrin applications 7 days apart before switching to another class of medication (6). Neurotoxins like permethrin require two treatments because developing lice eggs will not be harmed (3,21). A second treatment during week two will kill any lice that were missed by the first treatment (16).

Permethrin is one of the cheapest options available to treat lice, and it can be used in patients older than 2 months (6). Different treatment options are used to treat children of different ages, but permethrin has the lowest age limit. Unfortunately, worldwide resistance is increasing to permethrin (7). A study in Great Britain showed a drop in efficacy from 97% in the 1990s to 13% in 2013 (22).

There are numerous second-line agents available for lice treatment, and in light of increasing resistance to permethrin, it is important to understand the risks and benefits of each one. The dimeticones, a mixture of isopropyl myristate 50% and ST-cyclomethicone 50%, and benzyl alcohol 5% are the other second-line treatment options approved in Canada.

A promising newer therapy is the dimeticones. Dimeticones are synthetic silicone oils. Lice have small breathing holes in their exoskeletons called spiracles, and dimeticones work by closing over these holes to suffocate the lice (7). They are considered biochemically inert and nontoxic (6). A benefit of dimeticones is that the development of resistance is very unlikely because of the physical mechanism of action. A drawback is that the dimeticone products available are different from each other and not all products have the same level of efficacy. One product that is a mixture of two different dimeticones called NYDA was shown to have an efficacy of 97% (3). Another

option is a mixture of isopropyl myristate 50% and ST-cyclomethicone 50% that dissolves the louse exoskeleton leading to dehydration and death. Treatment must be repeated a week later, and side effects are limited to scalp pruritis and erythema (6). Benzyl alcohol 5% causes asphyxiation with similar side effects of pruritis and erythema. It is associated with neonatal gasping syndrome (16).

There are many household cures that claim to treat lice including petroleum jelly, olive oil, and butter. There is not currently any high-quality evidence to support the use of these home remedies (5).

There are other agents that have not yet been approved for use in Canada or whose use for lice is simply off-label. Ivermectin can be used topically and orally, and it is the only oral option available. Some other treatments that are used include Spinosad, a product derived from the soil bacterium *Saccharopolyspora spinosa*, and an organophosphate called malathion .5% (16). Spinosad is expensive and requires a prescription. Malathion smells bad and is highly flammable with documented resistance in Europe (16). Previously lindane 1% was used frequently for lice but it is no longer recommended because of neurotoxicity and bone marrow suppression risks (6,8,16).

While there are many options available, a few clear principles guide treatment. The synchronicity of treatment of close contacts is key to interrupting the exponential spread of lice infestations in a school, family, or community. An important part of every treatment regimen is wet combing. It is the most sensitive method for diagnosing and monitoring a lice infestation to follow treatment progress, and it is intrinsically therapeutic as lice are removed by the process (23). Wet combing should be used to screen anyone who may be affected. It is recommended to treat any bedmates regardless of if any nits or lice are found (5). That being said, the American Academy of Pediatrics and the Canadian Pediatric Society both recommend against “no-nit” policies for schools (6,16). Children should receive a full course of treatment and should avoid head-to-head contact, but they should not be kept from going to school, daycare, or spending time with friends.

Rising resistance to permethrin most likely will lead to limited usefulness of the drug in the future, but thankfully there are many more options available for treating lice. The safety and efficacy of dimeticones may cause them to become the agent of the choice in the future. Other available agents should be considered based on their individual risks and benefits.

## **Case Resolution**

### **Putting all of this together, what should we do for Sam?**

You instruct Sam’s mother to try using a dimeticone solution, a second line agent since he has failed treatment with the first line treatment permethrin. You also provide Sam with a prescription for an anti-histamine to take as needed in case his itching becomes unbearable. The itching may last for a few days. Sam should continue to go to school after his first treatment, but he should limit head-to-head contact with others to the best of his ability. You also tell his mother that it may be prudent to wash any items in close contact with his head such as hats or pillowcases in hot water if he will want to use them in the next couple of days. You encourage her that it is very common for school-age children to get lice and that it is not a sign of poor hygiene. Since

asymptomatic carriers are common, the rest of the family should be screened for lice with wet combing and treated at the same time as Sam if needed.

**Great job!! We took care of Sam and learned a lot about lice. Let's move on to scabies.**

### **Here's our second case.**

Sally is a 13-year-old girl who presents saying that she is itching all over. Her hands, elbows, arms, and stomach all itch, and it gets worse at night. It has been going on for a couple of weeks; she is not sure when it started. She has never experienced anything like this before. She has no significant past medical history, takes no chronic medications, and she lives at home with her mom, dad, and seven siblings. She normally does well in school, but she failed a history test last week. The itching has been keeping her from sleeping, and she can't seem to study very well because of how tired she feels. Physical exam is notable for several serpiginous grey lines in the between her fingers. There are erythematous pustules in the axilla and periumbilical area. There are several excoriations on the backs of her hands and her abdomen, but an excoriation over the extensor surface of her right arm is more erythematous than the others and has a honey-colored crust. The rest of her physical exam is unremarkable. As you finish your exam Sally mentions that several of her other siblings have been itching as well. **What is on your differential diagnosis for Sally?**

Did this sound like scabies to you? Good job. Let's learn about scabies together and then see if we can figure out what we should do next for Sally.

### **Scabies Mite Biology**

Scabies is caused by the mite *Sarcoptes scabiei* (24). It is thought to have been discovered in 1687, and it is historically significant for possibly being one of the first discovered causes of human disease (24). Estimates of the life span of the mites vary, but short estimates range 7-10 days and longer estimates suggest 26-40 days (24). Eggs hatch in 2-3 days, and they are thought to mature in about 10 days (25). There are other types of scabies mites that are hosted by animals like dogs, but only the human mites are able to reproduce successfully while infesting a human host. Since infestations from mites normally hosted by other animals are not able to reproduce successfully the infestations are typically minor and self-limiting (26,27).

### **Predisposing factors, Exposure, and Epidemiology**

There are an estimated 200 million people in the world with scabies. The greatest burden is found in East Asia, Southeast Asia, Oceania, and Tropical Latin America (28). It is on the World Health Organizations list of neglected tropical diseases as of 2017 (29). Transmission occurs primarily through prolonged direct body exposure (26,27,30), with adult mites using heat and odor to locate new a host (25). In adults transmission often occurs through sexual contact (26), and in children, it is often from sleeping in the same bed as someone else infested (25). Transmission probability is directly proportional to the number of mites on the host (25). Fomite transmission only

plays a minor role because the mites will not survive longer than two days away from the host in most circumstances (30). The exception to the rule is in crusted scabies where the mite numbers are so high that fomites become much more contagious (25).

Children and the elderly are at the highest risk for becoming infested with scabies (27). It is associated with poverty and crowded living conditions (31). Places where people are crowded together and cannot leave such as prisons, refugee camps, and nursing homes can create environments where more than 70% of people will have scabies at any one time (31).

### **Clinical Manifestations (LO#1)**

Scabies has three main clinical presentations, classic, crusted, and nodular (25). Classic scabies presents with pruritis that can be quite severe and is characteristically worse at night (30). The itching causes sleeplessness and has been demonstrated to reduce productivity (31). Erythematous papules and burrows may be seen. Burrows appear as small gray lines in the skin. Typical locations include the interdigital web spaces, flexor areas of wrists, extensor areas of elbows, the axilla, genitalia, abdomen, intergluteal cleft, and the periareolar area (25–27,32,33). Infants can have pustules and vesicles on the palms and soles of the feet, the neck, and the face (8). The itching and development of these skin findings are the results of a type IV delayed allergic reaction to the mite (25). For this reason, it takes several weeks before any changes can occur (30). Secondary re-infestations will show themselves more quickly (25).

If a characteristic burrow is seen this is very helpful, but they are often not present in patients living in tropical climates or in children (25). Skin lesions can vary markedly in their appearances. In fact, the necessary differential for scabies includes almost every other rash that itches (25). It is common for children not to be diagnosed until an adult in close contact with them is correctly diagnosed (25). The variety of skin presentations and the delay between infestation and symptom onset makes diagnosis challenging (25).

Crusted or Norwegian scabies is a presentation of scabies where millions of mites are present (27,34). It occurs in immunocompromised patients and is associated with HIV, human t-lymphotropic virus type 1, and long term immunosuppressive therapy use (25). In crusted scabies hyperkeratotic skin crusts form that shed large numbers of mites (25,34). About half of patients with crusted scabies do not itch (25,27,30), and lesion distribution is often different than in classical scabies including the scalp (32,34). These patients are very contagious. The high number of mites involved can make it so that one case of crusted scabies can become the source of a perpetual scabies outbreak around the patient (27). Crusted scabies has a high mortality rate (31).

Nodules can be a rarer manifestation of scabies representing granulomatous inflammation surrounding a mite or mite feces (26). These can persist for months following treatment (27) and can be very itchy. Corticosteroid injections are sometimes used to help with the itching (25).

Secondary bacterial infection of scratches may occur, typically from group A *Streptococcus pyogenes* or *Staphylococcus aureus* (34,35). These infections are the source of much of the morbidity of scabies as they can lead to glomerulonephritis, rheumatic heart disease, and sepsis (36).

## **Diagnostic Methods (LO#2)**

If scabies is suspected, there are a few different diagnostic options available to help confirm the diagnosis. A burrow ink test can be performed by covering a lesion with ink and then wiping it away again with an alcohol swab. If a burrow is present, then the ink will trace down into the burrow making it easier to see (30). Dermatoscopy, or simply looking at the skin using a magnified view, can be very helpful in identifying mites and burrows. This is not very practical in many settings, however, especially in more remote locations (30). Handheld lower magnification power devices can be very helpful (37). Light microscopy of a KOH skin scraping may allow for visualization of a mite or eggs. This method is very specific but has a low sensitivity (25). Tape can also be applied to burrows in an attempt to capture mites for light microscopy (32). There are data to suggest that using tape can be more sensitive than skin scraping (38). Skin biopsy can be used to diagnose scabies, but it relies on the sample examined to have transected a mite or its eggs (25). Regardless of the method, it is important to choose a site that has not been scratched too much in order to increase the diagnostic yield. Sites that have not been scratched yet are more likely to still have evidence of a mite or mite products inside (25).

## **Let's check back on Sally. What do you think we should do to confirm our suspicion of a scabies infestation?**

You perform a burrow ink test and see when you wipe away the ink that some of the ink did sink down into the gray lines you noticed in between her fingers. Next, you apply some oil to a scalpel blade and perform a skin scraping over a burrow in an area that has not been scratched very much. You apply KOH and look with light microscopy and are rewarded for all of your hard work by seeing a scabies mite.

## **Now that you have confirmed the diagnosis, what treatment should we give Sally?**

### **Treatment (LO#3)**

First line treatment for scabies infestation for patients over 2 months of age is topical permethrin 5% cream applied to the entire body except for the head and neck (25,26,30,32). Infants should have the cream applied to the head and neck as well (30). The cream is washed off 8 hours later. Often this will completely eradicate the infestation, but if symptoms continue treatment can be repeated a week later. There are no reports of human scabies mite resistance to permethrin, but there has been a confirmed case of resistance in a dog (32).

It is important to inform patients that inflammatory reactions caused by the beginning of treatment often initially worsen itching and that symptoms can persist for four weeks (26,30,39). Antihistamines and topical corticosteroids can be given to help (25,26).

Synchronization of treatment with all household contacts is absolutely critical to successful treatment (27,30,33,39). Since the infestation can remain asymptomatic for weeks it is important for everyone involved to be treated. This is a common cause of treatment failure(25).



Environmental decontamination is of debated importance in treating scabies infestations since most scabies mites will die within two to four days of being off of their host (30). Colder temperatures and higher humidity allow the mite to survive longer before drying out, and so the exact length of time needed depends on the local climate (24). The Canadian Pediatric Society recommends all bed linens and clothing worn next to the skin to be washed and dried on hot cycles or stored in a plastic bag for seven days (30). Children can return to school the day after beginning their first treatment (30). Secondary bacterial infection is common by *Streptococcus pyogenes* or *Staphylococcus aureus*, and cephalexin is often given (27).

Second line treatment for scabies is benzyl benzoate 25%, but it often causes skin irritation and must be repeated during the second week (30). Benzyl benzoate should not be used under 6 months of age and should be diluted for children under age 12. For infants under 2 months, Crotamiton can be used. It must be applied for 24 hours and then washed off for 3 consecutive treatments.

Finally, for patients over 15kg and over 5 years old oral ivermectin is an effective option for treating scabies. A recent Cochrane review found no difference in efficacy between topical permethrin and oral and topical ivermectin (34). The oral dose is repeated a week later. In 2015 a study in Fiji showed that oral ivermectin is superior to topical permethrin when used in mass drug administration in reducing scabies prevalence (36).

Crusted scabies requires a different treatment approach due to the high number of mites. Treatment typically includes topical keratolytics, scabicides, and oral ivermectin simultaneously (27). These patients are very sick, and they should be taken care of inpatient by an infectious disease expert. Fomite decontamination also plays a much greater role (27).

Looking towards the future, research has been done demonstrating that it should be possible to create a scabies vaccine (24,32). The successful development of a scabies vaccine would be an exciting step forward in global public health.

### **Let's wrap up our case:**

You give Sally 5% permethrin cream with instructions to apply it to her entire body below the neck overnight and then to wash it off in the morning. You suspect the scratches on her right elbow may now have impetigo and give her cephalexin (40). You also give her an antihistamine to help with the itching, letting her know that it is common for the itching to get worse before it gets better. She goes home with instructions to have her entire family to be treated at the same time because several of them are most likely already infested themselves.

This concludes this podcast on lice and scabies. Thank you for listening.

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