

Head Lice

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The head louse, *Pediculus humanus capitis*, is a tiny insect about the same length as a sesame seed (Fig. 1). It can crawl rapidly across the scalp, but cannot fly or jump. Head lice live on people and cannot survive successfully on pet animals. They feed by piercing the skin to take small blood meals and are generally found associated with hair on the neck and scalp. This human ectoparasite (parasite that lives on the surface of a host) causes scalp itching, sleepless nights, and scratching that can lead to secondary skin infections. But more noteworthy is the impact of related stress, school days missed by students, and workdays missed by parents and guardians.



Figure 1. A. Female human head louse. B. Male human head louse. Both images: Shujuan Li

Pediculosis, or "lousiness", is one of the most prevalent communicable conditions in the United States. Head lice infestation is very common. It has been estimated that up to one in every 10 children in school acquires head lice at some time during their years in school. Head lice can infest people of all ages, but children are more prone to infestations due to their play activity and close physical contact. Girls acquire head lice more frequently than boys, because of hugging and head-to-head "selfie" image capture habits.

The direct health impacts of head lice feeding on the scalp may be negligible, but inappropriate treatments can pose real health hazards to children and members of the household. According to the Centers for Disease Control and Prevention (CDC) (2010), an estimated 6 million to 12 million infestations occur each year in the U.S. among children 3 to 11 years of age (http://www.cdc.gov/parasites/lice/head/gen_info/faqs.html). The economic impact of head lice in the U.S. is estimated at \$1 billion dollars annually, which includes direct costs (treatments and tools used to manage lice and nits) and indirect costs (missed school and work days, misdiagnosis, misuse of pediculicides and unnecessary expenditure) (Hansen and O'Haver 2004).

The beginning of the academic year seems to be when the number of lice cases peak each year. Head lice are now tougher to control than ever as documented in a new journal publication by Yoon and his colleagues (2015). In fact, 25 states have head lice populations that are highly resistant to the most commonly used lice shampoo treatments (Fig. 2), including pyrethrins and the pyrethroid insecticide permethrin. The research work is continuing, but most states tested so far have lice that are resistant to the popular over-the-counter lice treatment options (Yoon et al. 2015).

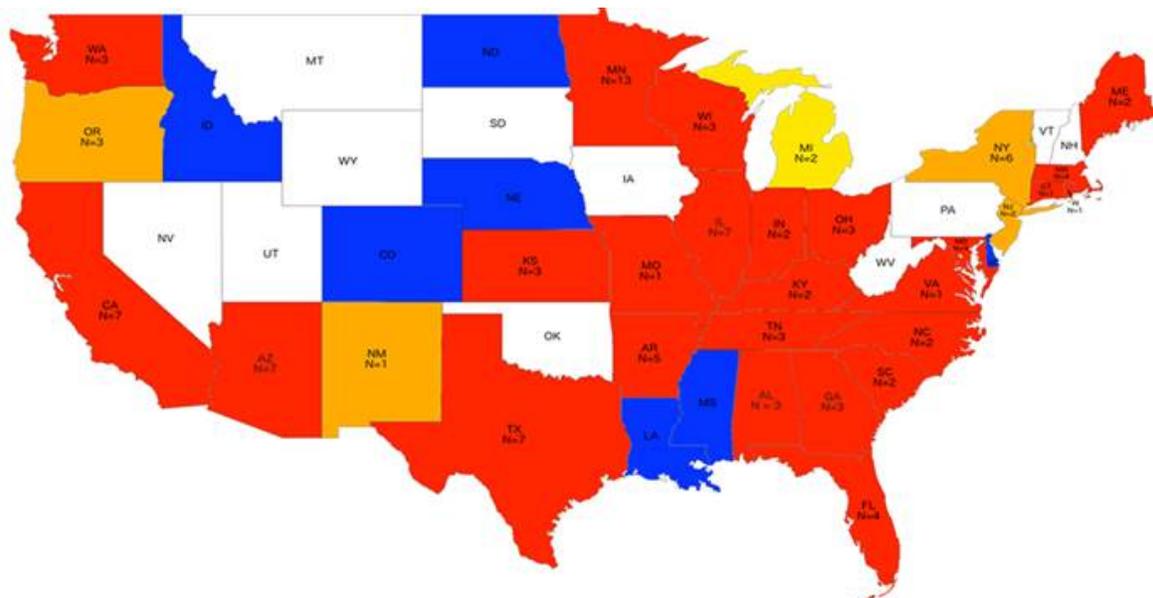


Figure 2. Lice populations have developed a high level of resistance to some of the most common head lice treatments. Red states: 100% of the tested lice were resistant. Orange states: 50 - 90% of lice were resistant. Yellow states: 1 - 49% were resistant. Blue States: Data hasn't been analyzed yet. White states haven't been tested. Image: Kyong Yoon, Southern Illinois University

DON'T PANIC! YOU CAN STILL DITCH THE ITCH!!!

Because of pesticide resistance challenges, it is more important than ever to use an integrated pest management (IPM) strategy to battle this “lousy” pest. **Using multiple complementary control tactics and paying careful attention to results is critical.** Relying on a one-step / one-tactic “fix” has little chance of success. We are encouraging parents, teachers and childcare professionals to be aware of this pest and know how to manage it.

Know Lice = No Lice

1. Head Lice Facts

Head lice **do not** have wings or legs designed for jumping. They can crawl rapidly across the surface of the scalp and move around in hair using specially adapted claw-like structures at the ends of their legs (Fig. 3). Head lice prefer to live on the hair of the head, although they have been known to wander to other parts of the body. Because head lice feed every 4 - 6 hours, they must remain in close contact with the host. They are unable to survive away from a human host for more than about 48 hours (thus, they cannot live within rugs, carpets, or vehicles). Head lice are not found on animals or household pets, and are not transmitted from pets to humans.



Figure 3. The tarsal claw at the end of each head louse leg. A. Notice the claws on legs of a male head louse; B. A head louse is grasping on a hair. Both images: Shujuan Li

Lice eggs are called nits. Nits are oval in shape (1/16 inch long), and camouflaged with the host's own hair pigment. They are usually glued to hairs by female lice on the head near the scalp (Fig. 4). Nits are quite often found on hair around a person's ears and back of the head. Eggs will hatch in 7 - 10 days under normal conditions. Once a nit hatches, a nymph (immature) leaves the shell casing that then appears white in color. The empty nits are far more obvious to the observer and unless physically removed they can remain attached to the hair and eventually grow out over time.

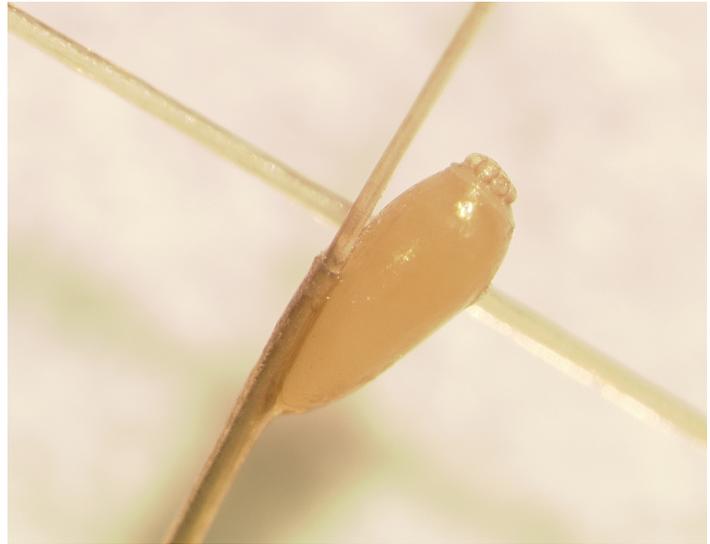


Figure 4. Egg of the head louse on a hair.
Image: Shujuan Li

Both nymphs (immatures) and adults (Fig. 5) have piercing-sucking mouthparts to pierce the skin for a blood meal. Within an hour of hatching, a nymph will take its first blood meal. It passes through a total of 3 nymph stages during the next 10 - 12 days before reaching the adult stage (1/8 inch long). The female louse can mate and begin to lay eggs soon after becoming an adult. Females may live up to 40 days, laying 3 - 7 eggs per day, up to 50 - 100 eggs during their lifetime! **A new generation of head lice can occur every 3 weeks.**

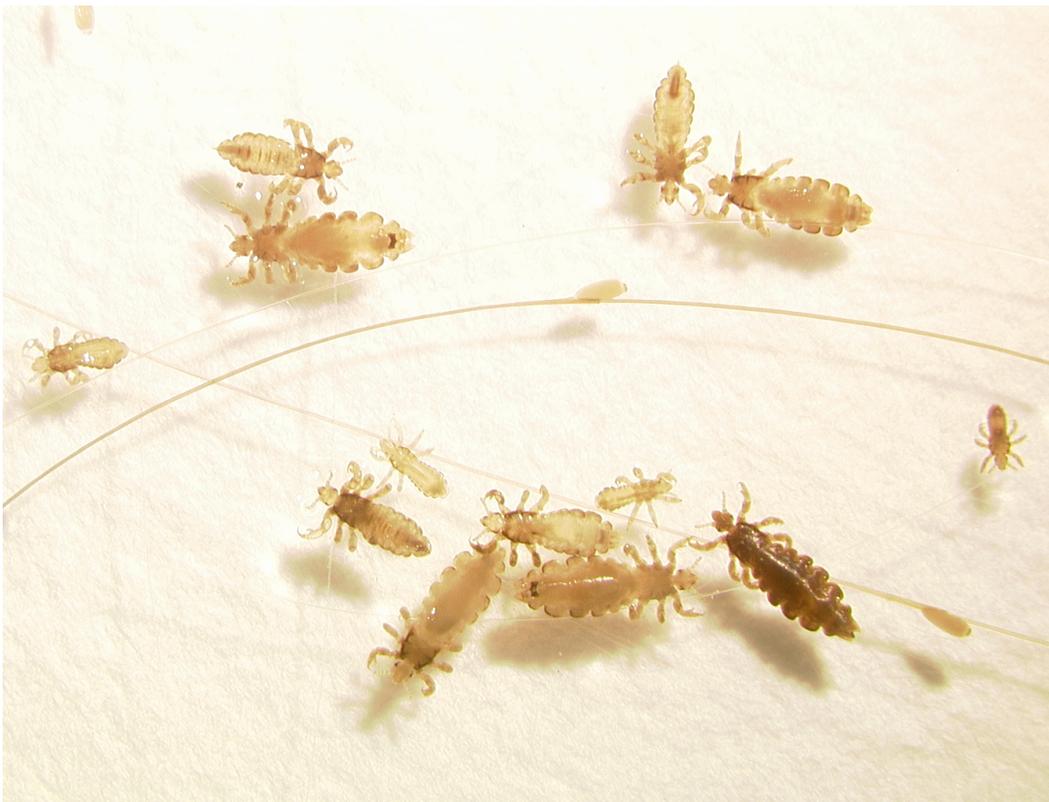


Figure 5. Head Lice eggs, nymphs and adults. Image: Shujuan Li

The reaction of individuals to louse bites can vary considerably! Most often people previously unexposed to lice experience little irritation from their first bites. But many individuals become sensitized to the lice saliva that is injected when they feed, and itching is a common reaction to the constant biting. Reactions include reddening of the skin, itching, and overall inflammation. Broken skin due to constant itching leads to further treatment complications so catching infestations early is important.

2. Checking for Head Lice

Periodic inspections for early detection of individual lice are far easier than dealing with advanced infestations (Fig. 6). In fact, the problem of head lice can be so rampant among preschool and school-aged students that often schools must work in conjunction with many families to control an infestation. **During the early fall months (August to November) children should be inspected weekly by parents or guardians.** Inspect for head lice using the following steps:

1. Shampoo and condition hair first.
2. Remove tangles with a comb or hairbrush.
3. Begin with good lighting for your inspection. A lamp or good natural light from a window works.
4. Use a hand lens or magnifying glass to help verify that what you find are indeed nits or lice. There is a lot of natural “debris” in hair that can be mistaken for eggs and lice.
5. Divide the hair in sections and fasten the hair that is not being worked on using clips.
6. Look for nits near the scalp. Eggs more than 1/2 inch (1 cm) away from the scalp are nearly always hatched, not viable or dead and **do not**, by themselves, indicate an active infestation or a need for treatment.
7. If, however, adults or lots of nits (more than 5 nits occurring in the area of a dime) are found close to the scalp, this is a call to action. Also check everyone in the household, including adult family members.



Figure 6. Check for head lice.
Image: Shujuan Li

3. Head Lice Treatment

Never initiate a head lice treatment unless there is a clear diagnosis with living adult or immature lice present. Parents, childcare professionals, caretakers and pediatricians should use products or methods that are effective, and most importantly, safe.

3.1. Pediculicide Treatments

3.1.1. Over-the-counter lice shampoos

Many over-the-counter lice shampoo products (pediculicides) sold in pharmacies and supermarkets contain insecticides, including pyrethrins and the pyrethroid insecticide permethrin, and if they are not used properly they can be hazardous (Fig. 7). When using a pediculicide shampoo, minimize body exposure by confining the product to the head hair. Wash the infested person's hair in a basin or sink so insecticide residues do not reach other parts of the body.



Figure 7. Follow label directions

✗ Never apply treatments to children in the bath or shower!

The person applying the treatment should wear chemical resistant gloves. Never apply an insecticide to anyone who has open cuts, scratches, or inflammations, and never use these materials on infants. **Consult a doctor if you have an infested infant.**

✓ In all cases, follow label directions completely and carefully.

As previously discussed there is widespread resistance to the most commonly used over-the-counter pediculicides. If effective, lice should die within 30 minutes of a treatment. If you find live lice after 30 minutes, discontinue use of that product. Switch to a different kind of product that does not rely on the same active ingredient (Fig. 8).

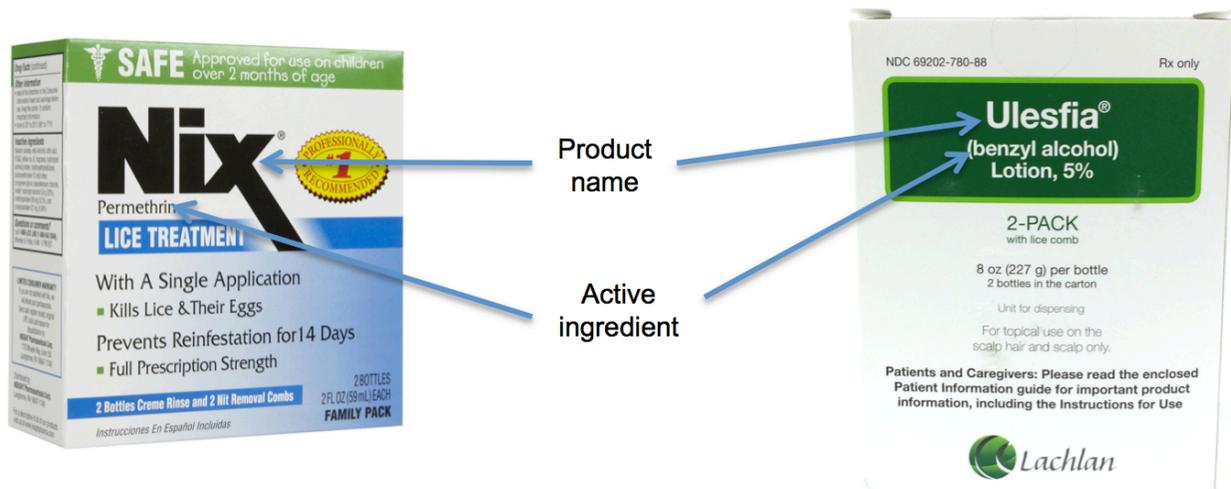


Figure 8. Locate the active ingredient information. Image: Shujuan Li

Pediculicidal products are for external use only, and should only be applied to the scalp. These products may be harmful if swallowed or inhaled. If accidental ingestion occurs, contact poison control immediately at (800) 222-1222 (Fig. 9).

3.1.2. Prescription lice treatment options

There are relatively new prescription pediculicides, so investigate the pros and cons associated with each. Very effective prescription options include [Ulesfia®](#) (benzyl alcohol), and [Natroba™](#) (spinosad and benzyl alcohol).

Pros: [Ulesfia®](#) and [Natroba™](#) are highly effective treatment options and can be used to treat head lice on children as young as 6 months old.

Cons: Both products contain benzyl alcohol, and are flammable. Do not allow anyone to smoke or stand near a naked flame while treating or being treated with these products. You should not use either product if you or the person you are treating is allergic to benzyl alcohol (relatively few people are). Benzyl alcohol products should not be used on infants younger than 6 months.

Ulesfia® (benzyl alcohol) is not neurotoxic, but it is a highly effective lotion used for the topical treatment of head lice in patients 6 months of age and older. Like most treatments Ulesfia® is not ovicidal (does not kill all the eggs), so 2 treatments are necessary. This product is a prescription-only treatment with no resistance issues reported, and is currently one of the most effective products with minimal side-effects (the most common side-effect being mild drying of the scalp).



Figure 9. Contact Poison Help

Some FDA approved prescription treatments are significantly more hazardous than others e.g., products that contain malathion, and lindane have more significant health risks associated with their use. Both active ingredients are older pesticide options, and may not be as effective as newer, safer products.



Be informed before you visit your pediatrician, avoid high risk and poorly performing control options.

In general, most lice treatment products have limited ovicidal (egg-killing) activity, so two treatments are needed. Skipping the second treatment often leads to re-establishment of head lice, and that necessitates an additional two treatments.



The second treatment is required to kill lice that hatch after the first treatment has occurred. Typically the second treatment follows 7 - 10 days after the first, depending on the product used.



Do not be tempted to repeat treatments sooner than recommended. The correct timing is important, and exposing children to more treatments than necessary increases the health hazards associated with the treatments.

Important Do's:



- **Do take an integrated pest management approach (monitor, vacuum home furniture, launder bedding, towels and clothes, treat the head, nit-comb, and evaluate results)**
- **Do follow pediculicide product directions exactly as written.**
- **Do second pediculicide treatments as directed on product labels.**
- **Do use gloves when applying treatments if the label directions indicate their use.**
- **Do invest time in manual nit removal, infestations will be resolved faster.**
- **Do try to relax and relax your child, head lice cause no harm and can be dispatched completely.**

Important Do not's:



- **Do not treat with a pediculicide if there is no evidence of live nymphs or adult head lice.**
- **Do not use a pediculicide shampoo as a routine shampoo, the products do not prevent a person from getting head lice.**
- **Do not assume a one-step treatment will be 100% effective at killing lice and eggs.**
- **Do not have a child rinse out treatments in the shower or a bathtub, aim to prevent any other part of the child from exposure to the pesticide.**
- **Do not leave products on the head for longer than directed.**
- **Do not retreat sooner than directed.**
- **Do not panic, it simply doesn't help.**

3.1.3. Alternative Approaches

In addition to pediculicide treatments, people also commonly use approaches with other products such as petroleum jelly, mayonnaise, margarine, herbal oils, enzyme-based products and olive oil. While there is no conclusive evidence that these treatments are effective, any time you wash the hair and scalp, you kill some head lice in the process.

Suffocants – petroleum jelly, mayonnaise, olive oil, or Cetaphil Gentle Skin Cleanser

Suffocants smother adult lice and to some extent nits by preventing air exchange. Many are massaged on the entire surface of the hair and scalp, the head is then covered with a shower cap, and left on for several hours. Usually the process is followed by nit combing.

Diligent shampooing is usually necessary for at least the next 7 days to remove the residue of suffocants. It is likely that benefit is afforded by both the treatment and the subsequent washing, combing and drying.

If you wish to try this approach but don't want the difficulty of removing sticky residues from the hair, try using soap shampoos that contain coconut or olive oils. Begin with daily shampooing and use of hair conditioner. 1% coal tar shampoo can help to calm an irritated scalp and reduce dandruff (which can be mistaken for lice), and rich hair conditioners e.g., Fekkai hair conditioners, help the nit combing process greatly. Each successive shampooing and conditioning kills some lice.

Cetaphil Gentle Skin Cleanser can be used as follows: massage the cleanser on to the entire surface of the hair and scalp. Comb out any excess product, then dry the hair completely with a hair dryer, and leave the dried product on the hair for 8 hours. The hair can then be washed and the process should be repeated several times over the next couple of weeks. A study by Pearlman (2004) documented a high success rate (>94%) even without nit combing. If nit combing is for some reason impossible, this may be a very good treatment choice.

Enzymes - LiceLogic, Lice B Gone, Lice R Gone

Treatment products containing “enzymes” work by dissolving or softening the glue that attaches the nit to the hair shaft, promoting nit removal during combing. Some lice are also killed in the process.

Desiccation (heat treatment) – AirAllé™ (formerly known as LouseBuster™) and hair dryer

The AirAllé™ (formerly known as LouseBuster™) is a machine that uses hot air to desiccate lice and eggs (Fig. 10). One study showed high mortality of eggs and hatched lice (Bush et al. 2011). The device is sold primarily to professionals for use in schools, clinics, and places where lice are commonly treated.



Figure 10. The machine uses hot air to desiccate lice and eggs. Image: AirAllé™

A home hair dryer may not be as effective as the AirAllé™ but hair drying will desiccate some lice and eggs each time it is used.



Hair-drying with a dryer on a warm heat setting, and hair-brushing are effective ways of killing lice mechanically.

Manual Removal

Taking an integrated pest management approach including the use of multiple management options is critical to controlling head lice because **20 to 30% of lice can still be alive after shampoo treatments** (and survival can be much higher if you are tackling pesticide resistant lice). Nits (especially the ones within half an inch of the scalp) should be removed manually after treatment with any product. Manual removal of nits can be difficult and tedious, but it will help

to diminish the social stigma and isolation a child can experience in school, enhance the relationship between a parent and child, and decrease diagnostic confusion.

Unfortunately many students are sent home from school because of old hatched nits growing out along the length of the hair that become more noticeable over time. Thankfully many school districts are removing “no nit” policies, as there is no benefit to the policy, and schools lose a great deal of funding due to unnecessary absenteeism.

Special combs are needed for nit removal and will be effective if used diligently each day. It is recommended that combing continue for 10-14 days. Nit combs (Fig. 11) come in many forms and they are all helpful. The LiceMeister® or Nit Free Terminator combs are great choices. Some useful tips follow.



Figure 11. An example of a great lice comb

- Use nit comb on wet hair.
- Conditioners help the comb move through the hair easier.
- Metal combs with stiff tines (teeth), and narrow slots between tines, are the best e.g., Nit Free Terminator Stainless Steel Lice Comb.
- Short-tined combs work best on short hair, long-tined combs work best on long hair.
- Rinse or wipe the comb after every few pulls through the hair.
- Use electrocution combs e.g., RobiComb® on dry hair.
- Use a magnifying glass and good lighting.
- Be gentle. If the comb gets tangled in the hair, it will be less effective at destroying and removing lice and eggs.

Using a nit comb to remove nits requires some time investment each day, how much time depends on the thickness and curliness of the hair, and how much experience you have. It's something most parents and guardians get better at each time they do it. A set of effective tools is shown in Fig. 12. To remove head lice and nits from the head use the following steps:

1. Have your child wash and condition their hair. An over-the-counter coal tar shampoo will help to soothe the scalp, and reduce dandruff and flakes of skin that can generate confusion. A heavy detangling conditioner will help the nit comb move through the hair easier.



Figure 12. A set of effective nit combing tools.
Image: Dawn Gouge

2. Have your child sit comfortably under good light. A movie or good book should keep them entertained.
3. After gently removing tangles, comb hair from the scalp to the ends, dividing hair into manageable sections. Infested heads can be extra sensitive so take the extra time to be gentle and thorough.
4. Dip the nit comb in a container of warm water, then place the tip of the tines on the surface of the scalp. Holding the comb at a 45° angle to the scalp (Fig. 13), slowly pull the comb from the scalp to the ends of the hair, and re-dip the comb in the water. Wipe the comb with tissue to remove lice and nits. When done, discard the tissue.
5. Look through that same section of hair for remaining nits and lice. Repeat if necessary.
6. Systematically comb through all hair.
7. Clean the nit removal comb with hot soapy water. An old toothbrush can help dislodge nits and lice that get caught in the teeth of the comb. If you are still concerned that you may have missed something place the nit comb in the freezer until the following day.



Figure 13. Comb hair at a 45° angle to the scalp.
Image: Al Fournier



Daily head checks and nit removal are advisable until the infestation is gone. Follow with weekly head checks for the whole family to detect any reestablishing lice.



Never resort to dangerous practices such as aerosol insecticide sprays or total release foggers (bug bombs), or highly flammable materials such as kerosene or gasoline!

3.2. Environmental Interventions

Once an infestation is detected, all towels and worn clothes should be laundered or dry-cleaned. Pillowcases, sheets, blankets and other bedding should also be washed and placed in the clothes dryer until completely dry. The dryer will kill the lice and their eggs. Any non-washable items should be dry cleaned or sealed in a plastic bag and placed in the freezer at 5 °F or lower overnight (this is a good option for headphones and other non-washable items). Vacuuming the home will remove shed hair that may have nits attached. **Remember, if lice are off the body for 48 hours they will die, so simply leaving things that cannot be laundered (very large stuffed animals, duvets, furniture, etc.) in a bag or “off-limits” for 48 hours will do the trick.**

**Remove lice and nits from the household environment.
Vacuum and clean where heads lay, then concentrate on infested heads.**

4. Control Measures in Schools

When parents of elementary school-aged children are surveyed as to what childhood health issues concern them most, head lice usually rank higher than more serious conditions (<http://www.health.mo.gov/living/families/schoolhealth/pdf/HEADLICE.pdf>). In reality this is a harmless insect that is easily taken care of if you use effective strategies and take the right management steps.

Three things everyone should know

- 1) In any school classroom 1% head lice incidence is normal.**
- 2) If classrooms report >20% infestation levels, it is likely that someone is misdiagnosing head lice.**
- 3) No pesticide treatment of a classroom, school bus or home is ever necessary or beneficial.**

Currently many school districts have “no nit policies”. A “no nit” policy is one that excludes students from school based on the presence of lice eggs, whether or not live lice are present. Such a policy has *not* been supported by research and is not recommended by experts, because:

1. Nits do not transfer between heads (CDC 2010).
2. The over-reaction to nits leads to unproductive use of time by school staff and parents, school days missed by students, and workdays missed by parents and guardians.
3. Nits more than a half inch from the scalp and are not viable. They are likely dead, empty shells or unlikely to hatch.
4. The misdiagnosis of nits is common during nit checks conducted by nonmedical personnel (CDC 2010), and even some medical personnel.
5. Misdiagnosis may lead to *unnecessary use of pediculicides* and inappropriate exclusion from school (CDC 2010).

Outdated “no nit” policies contribute greatly to the social stigma of lice infestations, but have absolutely no impact on preventing additional infestations in the community.

The experts agree:

The National Association of School Nurses state that “Nit free policies disrupt the education process and should not be viewed as an essential strategy in the management of head lice” (National Association of School Nurses, 2011).

The Center for Health and Health Care in Schools state that “Children with nits do not pose an immediate risk to the health of others, therefore, excluding these children from school and requiring them to be treated with pesticidal product is probably excessive” (<http://health.mo.gov/living/families/schoolhealth/pdf/HeadliceGuidelines.pdf>).

The American Academy of Pediatrics recommends that no healthy child should be excluded from or allowed to miss school because of head lice, and that “no nit policies” for return to school be discouraged (Devore et al., 2015).

Schools are advised to create a lice management plan and promote an integrated pest management (IPM) strategy to battle this pest.

Screening for nits alone is not an accurate way of predicting which children will become infested.

Children having 5 nits or more within 1 cm² of the scalp are significantly more likely to develop an infestation, but even then only 1/3 of these higher-risk children convert to having an active infestation.

Providing information to families on the diagnosis, treatment, and prevention of head lice is a helpful and useful plan. Parents and guardians should be encouraged to check their children’s heads for lice if the child is symptomatic.

In Summary, include in your home integrated pest management strategy:

1. On-going head lice monitoring of family members.
2. Laundering of bedding, towels, clothing and stuffed animals and throw-pillows.
3. Vacuum (especially couches or floor areas where children lay down).
4. Wash hair accessories, brushes, combs, etc. Items that cannot be washed can be placed in the freezer, or just placed “off-limits” for 48 hours.
5. Regular washing, conditioning, drying, and wet or dry-hair brushing.
6. Use the most effective and least-hazardous prescription treatments and nit removal when necessary.

Product names mentioned are registered trademarks. Any products, services, or organizations that are mentioned, shown, or indirectly implied in this publication do not imply endorsement by The University of Arizona.

References

Bush, S.E., Rock, A.N., Jones, S.L., Malenke, J.R. and Clayton, D.H. 2011. Efficacy of the LouseBuster, a New Medical Device for Treating Head Lice (Anoplura: Pediculidae). *Journal of Medical Entomology*. 48(1): 67-72.

Centers for Disease Control and Prevention. 2010. Head lice information for schools. Retrieved from <http://www.cdc.gov/parasites/lice/head/index.html>

Devore, C.D., et al. 2015. Head lice. *Pediatrics* 2015 May 1; 135:e1355. (<http://dx.doi.org/10.1542/peds.2015-0746>) - See more at:

<http://www.jwatch.org/na37715/2015/05/01/get-your-head-game-revised-head-lice-clinical-review?variant=full-text#sthash.8m0rct2o.dpuf>

Hansen, R.C. and O’Haver, J. 2004. Economic Considerations Associated with *Pediculus humanus capitis* Infestation. *Clinical Pediatrics*, 43 (6): 523-527.

National Association of School Nurses. Position statement: pediculosis in the school community. Silver Spring, MD: National Association of School Nurses; 1999 (Revised 2011). Available at: www.nasn.org/Portals/0/positions/2011pspediculosis.pdf. Accessed September 3, 2014

Pearlman, D.L. 2004. A simple treatment for head lice: Dry-on, suffocation-based pediculicide, *Pediatrics*, 114 (3): 275-279.

Yoon, K.S., Clark, J.M., et al. 2015. Lice in at least 25 states show resistance to common treatments. Presented at American Chemical Society. <http://www.smithsonianmag.com/science-nature/lice-can-resist-drugs-have-infested-half-states-us-180956308/?no-ist>; Press conferences from #ACSBoston by American Chemical Society: https://www.youtube.com/watch?v=l-YIQCYE8uo&index=11&list=PLLG7h7fPoH8I0bHbe9mnjum8w_hlEXQnH

Resources

More information regarding head lice management:

Head Lice <http://pediatrics.aappublications.org/content/135/5/e1355.full.pdf>

Head Lice (Sep. 2005) http://cals.arizona.edu/urbanipm/pest_press/index.html

The National Pediculosis Association,® Inc.: <http://www.headlice.org/>

IPM Action Plan for Head Lice <http://www.extension.org/pages/20989/school-ipm-action-plan-for-head-lice#.Uh4-YBYSMY5>

Head Lice Pest Press <http://cals.arizona.edu/apmc/westernschoolIPM.html#newsletter>

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