CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

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Head Lice

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abstract

Head lice infestation is associated with limited morbidity but causes a high level of anxiety among parents of school-aged children. Since the 2010 clinical report on head lice was published by the American Academy of Pediatrics, newer medications have been approved for the treatment of head lice. This revised clinical report clarifies current diagnosis and treatment protocols and provides guidance for the management of children with head lice in the school setting.

Head lice (*Pediculus humanus capitis*) have been companions of the human species since antiquity. Anecdotal reports from the 1990s estimated annual direct and indirect costs totaling $367 million, including remedies and other consumer costs, lost wages, and school system expenses. More recently, treatment costs have been estimated at $1 billion.[1] It is important to note that head lice are not a health hazard or a sign of poor hygiene and are not responsible for the spread of any disease. Despite this knowledge, there is significant stigma resulting from head lice infestations in many developed countries, resulting in children being ostracized from their schools, friends, and other social events.[2,3]

In the past, parents and other non–health care personnel made the diagnosis of head lice, and the easy availability of safe and effective over-the-counter (OTC) pediculicides often removed the physician from the treatment process. However, the potential for misdiagnosis and the resulting improper use of pediculicides and the emergence of resistance to both available and newer products, many without proof of efficacy or safety, call for increased physician involvement in the diagnosis and treatment.[4,5] Optimal treatments should be safe, should rapidly rid the individual of live lice, viable eggs, and residual nits, and should be easy to use and affordable.[6] Additionally, because lice infestation is benign, treatments should not be associated with adverse effects and should be reserved for patients on whom living lice are found.

ETIOLOGIC AGENT

The adult head louse is 2 to 3 mm long (the size of a sesame seed), has 6 legs, and is usually tan to grayish-white in color. The female lives up to 3 to 4 weeks and, once mature, can lay up to 10 eggs per day. These tiny eggs

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are firmly attached to the base of the hair shaft within approximately 4 mm of the scalp with a gluelike substance produced by the louse. Viable eggs camouflaged with pigment to match the hair color of the infested person often are seen more easily at the posterior hairline. Empty egg casings (nits) are easier to see because they appear white against darker hair. (Note that some experts refer to "eggs" as containing the developing nymph and use "nits" to refer to empty egg casings; others use the term "nits" to refer to both eggs and the empty casings). The eggs are incubated by body heat and typically hatch in 8 to 9 days, but hatching can vary from 7 to 12 days depending on whether the ambient climate is hot or cold. Once it hatches, a nymph leaves the shell casing and passes through a total of 3 nymph stages (instars) during the next 9 to 12 days before reaching the adult stage. The female louse can mate and begin to lay viable eggs approximately 1.5 days after becoming an adult. If not treated, the cycle repeats itself approximately every 3 weeks.[7]

The louse feeds by injecting small amounts of saliva, which has vasodilatory and anticoagulation properties, into the scalp, allowing the louse to suck tiny amounts of blood every few hours. Pruritus results from sensitization to components of the saliva. With a first case of head lice, pruritus may not develop for 4 to 6 weeks, because it takes that amount of time for sensitivity to result.

Head lice usually survive for less than 1 day away from the scalp, and their eggs cannot hatch at temperatures lower than those near the scalp.[8]

EPIDEMIOLOGY

In the United States, reliable data on prevalence of head lice are not available.[9] All socioeconomic groups are affected, and infestations are seen throughout the world. Head lice infestation is not significantly influenced by hair length or by frequent brushing or shampooing.

TRANSMISSION

Lice do not hop or jump; they can only crawl, and pets do not play a role in the transmission of human lice.[9] However, there are reports that combing dry hair can build up enough static electricity to physically eject an adult louse from an infested scalp for a distance of 1 m.[10] In most cases, transmission occurs by direct contact.[9,11] Indirect spread through contact with personal belongings of an infested individual (combs, brushes, hats) is much less likely to occur.[12] Lice found on combs are likely to be injured or dead,[13] and a louse is not likely to leave a healthy head unless there is a heavy infestation.[14] In 1 study, live lice were found on only 4% of pillowcases used by infested volunteers.[15] Thus, the major focus of control activities should be to reduce the number of lice on the head and to lessen the risks of head-to-head contact.

DIAGNOSIS

Identification of eggs (nits), nymphs, or adult lice with the naked eye establishes the diagnosis. This can be difficult sometimes because lice avoid light and can crawl quickly. Studies have revealed that diagnosis of infestation by using a louse comb is quicker and more efficient.[16] Some experts have suggested using a lubricant (water, oil, or conditioner) to "slow down" the movement of lice and eliminate the possibility of static electricity.[17] Tiny eggs may be easier to spot at the nape of the neck or behind the ears, within 1 cm of the scalp. It is important not to confuse eggs or nits, which are firmly affixed to the hair shaft, with dandruff, hair casts, or other hair debris, which are not. It is also important not to confuse live eggs with dead or empty egg cases (nits). Many presumed "lice" and "nits" submitted by physicians, nurses, teachers, and parents to a laboratory for identification were found to be artifacts, such as dandruff, hairspray droplets, scabs, dirt, or other insects (eg, aphids blown by the wind and caught in the hair).[5] In general, eggs found more than 1 cm from the scalp are unlikely to be viable, although some researchers in warmer climates have found viable eggs farther from the scalp.[8]

PREVENTION

It is unlikely that all head lice infestations can be prevented, because young children come into head-to-head contact with each other frequently. It is prudent for children to be taught not to share personal items, such as combs, brushes, and hats, but one should not refuse to wear protective headgear because of fear of head lice. In environments where children are together, infested children should be treated promptly to minimize spread to others. Regular surveillance by parents is one way to detect and treat early infestations, thereby preventing the spread to others.

TREATMENT

Never initiate treatment unless there is a clear diagnosis with living lice. The ideal treatment of lice should be safe, free of toxic chemicals, readily available without a prescription, easy to use, effective, and inexpensive. Local patterns of resistance (if known), ease of use, and cost (Table 1) also are considerations when choosing a treatment choice. Published reviews of available efficacy studies and comparative trials of pediculicides have used different inclusion criteria and reached different conclusions.[18–20] A Cochrane review concerning pediculicides has a substantial update under way, because previous reviews were conducted before the development of drug resistances.[21]

TABLE 1 Topical Pediculicides for the Treatment of Head Lice in the United States

Product	Availability	Cost Estimate
Permethrin 1% lotion (Nix)	OTC	$
Pyrethrins + piperonyl butoxide (Rid)	OTC	$
Malathion 0.5% (Ovide)	Prescription	$$$$
Benzyl alcohol 5% (Ulesfia)[a]	Prescription	$$-$$$$
Spinosad 0.9% suspension (Natroba)	Prescription	$$$$
Ivermectin 0.5% lotion (Sklice)	Prescription	$$$$

Adapted from refs 18, 40.

$, <$25; $$, $26–$99; $$$, $100–$199; $$$$, $200–$299.

[a] Cost varies based on the length of the hair and the number of bottles of medication required.

The guidance in this report is intended for use by pediatricians and other practitioners in the United States. The Canadian Pediatric Society recently updated its position statement on head lice infestation.[22] Pediatricians who work in other countries, especially developing countries in which head lice are naive to pediculicides, should use products or methods that are most economical, effective, and safe. The following products and methods can be effective for treating head lice.

Pediculicides

Permethrin (1%)

Permethrin has been the most studied pediculicide in the United States and is the least toxic to humans.[18] Introduced in 1986 as a prescription-only treatment, 1% permethrin lotion was approved for OTC use in 1990 and is marketed as a "creme rinse" (Nix; Insight Pharmaceuticals, Trevose, PA). One percent permethrin lotion is one of the drugs available to treat head lice.[23] Permethrin is a synthetic pyrethroid with extremely low mammalian toxicity. Reported adverse effects include pruritus, erythema, and edema. Permethrin is less allergenic than pyrethrins and does not cause allergic reactions in individuals with plant allergies. The product is applied to damp hair that is first shampooed with a nonconditioning shampoo and then towel dried. It is left on for 10 minutes and then rinsed off. Permethrin leaves a residue on the hair that is designed to kill nymphs emerging from the 20% to 30% of eggs not killed with the first application.[24] However, conditioners and silicone-based additives present in almost all currently available shampoos impair permethrin adherence to the hair shaft and reduce its residual effect.[6] Although many repeat the application sometime between day 7 to 10 after treatment if live lice are seen, new evidence based on the life cycle of lice suggests that retreatment at day 9 is optimal.[6,25] An alternate treatment schedule on days 0, 7, and 13 to 15 has been proposed on the basis of the longest possible life cycle of lice for this and other nonovicidal agents (eg, pyrethrins plus piperonyl butoxide).[26] Resistance to 1% permethrin has been reported,[6,27–30] but its prevalence is unknown.

Pyrethrins Plus Piperonyl Butoxide

Manufactured from natural extracts from the chrysanthemum, pyrethrins are formulated with piperonyl butoxide (eg, RID; Bayer HealthCare LLC, Whippany, NJ) and are available OTC. Pyrethrins are neurotoxic to lice but have extremely low mammalian toxicity. Pyrethrins should be avoided in people who are allergic to chrysanthemums. The labels warn against possible allergic reaction in patients who are sensitive to ragweed, but modern extraction techniques minimize the chance of product contamination, and reports of true allergic reactions have been rare.[31] These products are available in shampoo or mousse formulations that are applied to dry hair and left on for 10 minutes before rinsing out. No residual pediculicidal activity remains after rinsing. In addition, none of these natural pyrethrins are totally ovicidal (newly laid eggs do not have a nervous system for several days); 20% to 30% of eggs remain viable after treatment,[24] which necessitates a second treatment to kill newly emerged nymphs hatched from eggs that survived the first treatment. Suggested retreatment with these products is similar to permethrin (1%) described previously.[26] Although pyrethrins were extremely effective when introduced in the mid-1980s, recent study results have indicated that efficacy has decreased substantially because of development of resistance.[4] The prevalence of resistance has not been systematically studied but seems to be highly variable from community to community and country to country.

Malathion (0.5%)

The organophosphate (cholinesterase inhibitor) 0.5% malathion (Ovide; Taro Pharmaceutical Industries, Hawthorne, NY) was reintroduced for the treatment of head lice in the United States in 1999 after being taken off the market twice because of problems related to prolonged application time, flammability, and odor. It is available only by prescription as a lotion that is applied to dry hair, left to air dry, then washed off after 8 to 12 hours, although some study results have suggested effectiveness when left on for as short a time as 20 minutes.[32] Head lice in the United Kingdom and elsewhere have shown resistance to malathion preparations, which have been available for decades in those countries.[33,34] The current US formulation of malathion (Ovide lotion, 0.5%) differs from the malathion products available in Europe in that it contains terpineol, dipentene, and pine needle oil, which themselves have pediculicidal properties and may delay development of resistance. Malathion has high ovicidal activity,[24] and a single application is adequate for

most patients. When compared with pyrethrins and permethrin, malathion was the most pediculicidal and ovicidal agent with highest cure rates after 1 application.[6,32] However, the product should be reapplied in 7 to 9 days if live lice are still seen. The high alcohol content of the product (78% isopropyl alcohol) makes it highly flammable; therefore, patients and their parents should be instructed to allow the hair to dry naturally; not to use a hair dryer, curling iron, or flat iron while the hair is wet; and not to smoke near a child receiving treatment. Safety and effectiveness of malathion lotion have not been established in children younger than 6 years, and the product is contraindicated in children younger than 24 months. Because malathion is a cholinesterase inhibitor, there is a theoretical risk of respiratory depression if accidentally ingested, although no such cases have been reported.

Benzyl Alcohol 5%

Benzyl alcohol 5% (Ulesfia; Concordia Pharmaceuticals, Inc, Bridgetown, Barbados) was approved by the US Food and Drug Administration (FDA) in April 2009 for treatment of head lice in children older than 6 months. The product is not neurotoxic to the lice, but kills them by asphyxiation. Phase III trials of this agent have included 2 randomized, multicenter, double-blind, vehicle-controlled trials and 1 open-label study.[35] The overall end point of these trials was treatment success or no live lice at 14 days after the final application. The effectiveness of benzyl alcohol (75.0%–76.2%) was statistically greater as compared with vehicle placebo (4.8%–26.2%). The most common adverse reactions after treatment included pruritus (12%), erythema (10%), pyoderma (7%), and ocular irritation (6%).[17] When applied, sufficient amounts should be used on dry hair to saturate the scalp and entire length of the hair. Benzyl alcohol is not ovicidal and, therefore, should be applied topically for 10 minutes and repeated as stated previously for permethrin 1%. Benzyl alcohol is available by prescription and should not be used in neonates, because it has been associated with the neonatal gasping syndrome.[36]

Spinosad (0.9% Suspension)

Spinosad (Natroba; ParaPRO LLC, Carmel, IN) was approved by the FDA for topical use in children 6 months of age and older. It is contraindicated for children younger than 6 months because it also contains benzyl alcohol. The compounds, spinosyn A and spinosyn D, are derived through natural fermentation from soil bacterium, *Saccharopolyspora spinosa.* They are suspended in a natural ratio of 5:1 and together are known by the generic term spinosad. Spinosad has a broad spectrum of activity against insects, including many species of lice. Activity appears to be both ovicidal and pediculicidal by disrupting neuronal activity and lingering long enough to exert its effect on the developing larvae until they form an intact nervous system.[37] Superiority of spinosad over permethrin has been demonstrated with treatment success rates of 84% to 87% as compared with 43% to 45%.[38] Adverse reactions described include application site erythema (3%), ocular erythema (2%), and application site irritation (1%).[38–40] Spinosad is available by prescription and should be applied to dry hair by saturating the scalp and working outward to the ends of the hair, which may require a whole bottle. Spinosad should be rinsed 10 minutes after application. A second treatment is given at 7 days if live lice are seen. Safety in children younger than 4 years has not been established.

Ivermectin (0.5%)

Ivermectin (Sklice; Sanofi Pasteur, Swiftwater, PA), a widely used anthelmintic agent, was approved in a lotion form by the FDA in 2012 for children 6 months or older for head lice. This medication increases the chloride ion permeability of muscle cells, resulting in hyperpolarization, paralysis, and death of the lice.[41] Combined data from 2 multisite, randomized, double-blinded studies comparing a single application of 0.5% ivermectin lotion with a vehicle control found that significantly more patients receiving ivermectin were louse free on day 2 as compared with the control (94.9% vs 31.1%), day 8 (85.2% vs 20.8%), and day 15 (73.8% vs 17.6%; $P < .001$ for each comparison).[41] Topical ivermectin lotion is available by prescription, is applied to dry hair and scalp, and is rinsed after 10 minutes. Only 1 application is required, because when the treated eggs hatch, the lice are not able to feed as a result of pharyngeal muscle paralysis and, therefore, are not viable.[42] Adverse effects are rare and include skin or eye irritation and erythema, burning, or dryness.[41]

Lindane (1%)

Lindane is no longer recommended by the American Academy of Pediatrics or the *Medical Letter* for use as treatment of pediculosis capitis.

Removal of Topical Pediculicides

All topical pediculicides should be rinsed from the hair over a sink rather than in the shower or bath to limit skin exposure, and with warm rather than hot water to minimize absorption attributable to vasodilation.[43]

Topical Reactions

Itching or mild burning of the scalp caused by inflammation of the skin in response to topical pharmaceutical agents can persist for many days after lice are killed and is not a reason for retreatment. Topical corticosteroids and oral antihistamines may be beneficial for relieving these signs and symptoms.

Scabicides Used Off-Label for Lice

Permethrin (5%)

Permethrin 5% is not currently approved by the FDA for use as a pediculicide. Five percent permethrin (Elimite; Prestium Pharma, Inc, Newton, PA) is available by prescription only as a cream, usually applied overnight for scabies for infants as young as 2 months. It has been used for the treatment of head lice that seem to be recalcitrant to other treatments.[44] The results of 1 study suggested that lice resistant to 1% permethrin will not succumb to higher concentrations.[29]

Crotamiton (10%)

Crotamiton is not currently approved by the FDA for use as a pediculicide. This product is available by prescription only as a lotion (Eurax; Ranbaxy, Jacksonville, FL), usually used to treat scabies. One study showed it to be effective against head lice when applied to the scalp and left on for 24 hours before rinsing out.[45] Other reports have suggested that 2 consecutive nighttime applications safely eradicate lice from adults.[46] Safety and absorption in children, adults, and pregnant women have not been evaluated.

Oral Agents Used Off-Label for Lice

Ivermectin

This product (Stromectol; Merck & Co, Whitehouse Station, NJ) is an anthelmintic agent structurally similar to macrolide antibiotic agents, but without antibacterial activity. A single oral dose of 200 μg/kg, repeated in 10 days, has been shown to be effective against head lice.[47,48] Most recently, a single oral dose of 400 μg/kg, repeated in 7 days, has been shown to be more effective than 0.5% malathion lotion.[49] Ivermectin may cross the blood/brain barrier and block essential neural transmission; young children may be at higher risk of this adverse drug reaction. Therefore, oral ivermectin should not be used for children who weigh less than 15 kg.[50,51]

Sulfamethoxazole-Trimethoprim

The oral antibiotic agent sulfamethoxazole-trimethoprim (Septra [Monarch Pharmaceuticals, Bristol, TN], Bactrim [Mutual Pharmaceutical, Philadelphia, PA], and generic cotrimoxazole) has been cited as effective against head lice. It is not currently approved by the FDA for use as a pediculicide.[52] It is postulated that this antibiotic agent kills the symbiotic bacteria in the gut of the louse or perhaps has a direct toxic effect on the louse. The results of 1 study indicated increased effectiveness when sulfamethoxazole-trimethoprim was given in combination with permethrin 1% when compared with permethrin 1% or sulfamethoxazole-trimethoprim alone; however, the treatment groups were small.[53] Rare severe allergic reactions (Stevens-Johnson syndrome) to this medication make it a potentially undesirable therapy if alternative treatments exist.[7]

ALTERNATIVE APPROACHES

"Natural" Products

Essential oils have been widely used in traditional medicine for the eradication of head lice, but because of the variability of their constitution, the effects may not be reproducible.[54] In addition, these oils (eg, ylang ylang oil) may be a source of contact sensitization, which limits their use. Several products have been studied (eg, Andiroba oil, Quassia vinegar, melaleuca oil [tea tree oil], lavender oil).[55,56] As natural products, they are not required to meet FDA efficacy and safety standards for pharmaceuticals. HairClean 1-2-3 (Quantum Health, Eugene, OR [anise, ylang-ylang, coconut oils, and isopropyl alcohol]) was found to be at least as effective as the permethrin product Nix by 1 investigator.[2] Although many plants naturally produce insecticides for their own protection that may be synthesized for use by humans, such as pyrethroids, some of these insecticidal chemicals produce toxic effects as well. The safety and efficacy of herbal products are currently not regulated by the FDA, and until more data are available, their use in infants and children should be avoided.

Occlusive Agents

Occlusive agents, such as "petrolatum shampoo," mayonnaise, butter or margarine, herbal oils, and olive oil, applied to suffocate the lice are widely used but have not been evaluated for effectiveness in randomized controlled trials. To date, only anecdotal information is available concerning effectiveness.

An uncontrolled, nonrandomized 2004 study reported a 96% "cure" rate with Cetaphil cleanser (Galderma Laboratories, Fort Worth, TX) applied to the hair, dried on with a handheld hair dryer, left on overnight, and washed out the next morning and repeated once per week for 3 weeks. Instructions for its use are available on the Internet.[57] It has not been approved by the FDA for use as a pediculicide. Dimethicone lotion (4% long-chain linear silicone in a volatile silicone base) in two 8-hour treatments 1 week apart eradicated head lice in 69% of participants in the United Kingdom.[58] In the United States, the OTC product LiceMD (Reckitt-Benckiser, Slough, England) contains dimethicone, an emollient. Isopropyl myristate 50% (Resultz; Nycomed Canada, Inc, Oakville, Ontario, Canada), a hair rinse that dissolves the waxy exoskeleton of the louse, which leads to dehydration and death of the louse, has recently become available in Canada.[59,60]

Close surveillance of patients treated with non–FDA-approved products may improve discovery of treatment failure early, so other evidence-based and FDA treatments might be implemented.

Desiccation

The AirAllé (Larada Sciences, Salt Lake City, UT) device is a custom-built

machine that uses one 30-minute application of hot air in an attempt to desiccate the lice. One study showed that subjects had nearly 100% mortality of eggs and 80% mortality of hatched lice.[61] The machine is expensive, and the operator requires special training in its use. A regular blow dryer should not be used in an attempt to accomplish this result, because investigators have shown that wind and blow dryers can cause live lice to become airborne and, thus, potentially spread to others in the vicinity.

Other Agents

Highly flammable substances, such as gasoline or kerosene, or products intended for animal use, are never appropriate in treatment of head lice in humans.

Manual Removal

Although there is little peer-reviewed information in the literature about the benefits of the manual removal of live lice and nits, the inherent safety of the manual removal relative to the minor toxicity of the pesticides is real and can be part of an arsenal by pediatricians when determining treatment options. There is an obvious benefit of the manual removal process that can allow a parent and child to have some close, extended time together while safely removing infestations and residual debris without using potentially toxic chemicals on the child or in the environment. Furthermore, manual removal of nits will help to diminish the social stigma and isolation a child can have in the school setting. Individuals also may want to remove nits for aesthetic reasons or to decrease diagnostic confusion. Because none of the pediculicides are 100% ovicidal, nits (especially the ones within 1 cm of the scalp) should be removed manually after treatment with any product. Nit removal can be difficult and tedious.[62] Fine-toothed "nit combs" are available to make the process easier.[63–66] Nit-removal combs are sold commercially. However, it appears that type of comb used is less important than that combing occurs after treatment, which may be most easily accomplished on wet hair. Studies have suggested that lice removed by combing and brushing are damaged and rarely survive.[11]

There are battery-powered "electronic" louse combs with oscillating teeth (MagiComb; Quantum Health, Eugene, OR) that claim to remove live lice and nits as well as combs that resemble small "bug zappers" (Robi-Comb; LiceGuard LLC, Needham, MA) that claim to kill live lice.[67] No randomized, case-controlled studies have been performed with either type of comb. Their instructions warn not to use on people with a seizure disorder or a pacemaker.

Some products are available that claim to loosen the "glue" that attaches nits to the hair shaft, thus making the process of "nit-picking" easier. Vinegar or vinegar-based products are intended to be applied to the hair for 3 minutes before combing out the nits. No clinical benefit has been demonstrated.[7,68] This product has not been tested with and is not indicated for use with permethrin, because it may interfere with permethrin's residual activity. A variety of other products, from acetone and bleach to vodka and WD-40 (WD-40 Company, San Diego, CA), have proved to be ineffective in loosening nits from the hair shaft[68] and present an unacceptable risk to the patient. It seems that nature has protected the louse by making the nit sheath similar in composition to the hair, so that agents designed to unravel the nit sheath can also damage human hair.[69]

Although effective for removing lice and eggs, shaving the head generally is not required, nor recommended, because it can be traumatizing to a child and distressing to the parent.

New Products

As new products are introduced, it is important to consider effectiveness, safety, expense, availability, patient preference, and ease of application. Assessment of the severity of the infestation, the number of recurrences, the local levels of resistance to available pediculicides, exclusion of children from school, and the potential for transmission also are important when deciding about the use of newer products.

Pediculicide Resistance

No currently available pediculicide is 100% ovicidal, and resistance to pyrethrins, permethrin, and the United Kingdom formulation of malathion has been reported.[33,34,70–75] This resistance is not unanticipated, because insects develop resistance to products over time. The actual prevalence of resistance to particular products is not known and can be regional. It is important that health care professionals choose safe and effective products. When faced with a persistent case of head lice after using a pharmaceutical pediculicide, health care professionals can consider several possible explanations, including the following:

- misdiagnosis (no active infestation or misidentification);
- lack of adherence (patient unable or unwilling to follow treatment protocol);
- inadequate treatment (not using sufficient product to saturate hair; failing to follow directions);
- reinfestation (lice reacquired after treatment);
- lack of ovicidal or residual killing properties of the product (eggs not killed can hatch and cause self-reinfestation); and/or
- resistance of lice to the pediculicide.

If resistance is proven, and an active infestation is documented, benzyl alcohol 5% can be prescribed if the

patient is older than 6 months, or malathion 0.5% can be prescribed if the patient is older than 24 months if safe use by responsible parents seems reasonable. For younger patients, or if the parent cannot afford or does not wish to use a pediculicide, manual removal via wet combing or an occlusive method can be used, with emphasis on careful technique and the use of 2 to 4 properly timed treatment cycles.

ENVIRONMENTAL INTERVENTIONS

If a person is identified with head lice, all household members should be checked for head lice, and those with live lice or nits within 1 cm of the scalp should be treated. In addition, it is prudent to treat family members who share a bed with the person with infestation, even if no live lice are found. Fomite transmission is less likely than transmission by head-to-head contact[7]; however, it is prudent to clean hair care items and bedding used by the individual with infestation. One study revealed that head lice can transfer to pillowcases at night, but the incidence is low (4%). Changing just the pillowcase could minimize this risk of head lice transmission.[15] Only items that have been in contact with the head of the person with infestation in the 24 to 48 hours before treatment should be considered for cleaning, given the fact that louse survival off the scalp beyond 48 hours is extremely unlikely. Such items may include clothing, headgear, furniture, carpeting, and rugs. Washing, soaking, or drying items at temperatures greater than 130°F will kill stray lice or nits. Furniture, carpeting, car seats, and other fabrics or fabric-covered items can be vacuumed. Although head lice are able to survive for prolonged periods in chlorinated water, it is unlikely that there is a significant risk of transmission in swimming pools. One study revealed that submerged head lice became immobile and remained in place on 4 people infested with head lice after 30 minutes of swimming.[76] Pediculicide spray is not necessary and should not be used. Viable nits are unlikely to incubate and hatch at room temperatures; if they did, the nymphs would need to find a source of blood for feeding within hours of hatching. Although it is rarely necessary, items that cannot be washed can be bagged in plastic for 2 weeks, a time when any nits that may have survived would have hatched and nymphs would die without a source for feeding. Exhaustive cleaning measures are not beneficial.

CONTROL MEASURES IN SCHOOLS

Screening

Screening for nits alone is not an accurate way of predicting which children are or will become infested, and screening for live lice has not been proven to have a significant effect on the incidence of head lice in a school community over time.[8,19,77] In addition, such screening has not been shown to be cost-effective. In a prospective study of 1729 schoolchildren screened for head lice, only 31% of the 91 children with nits had concomitant live lice. Only 18% of those with nits alone converted to having an active infestation during 14 days of observation.[78] Because of the lack of evidence of efficacy, routine classroom or schoolwide screening should be discouraged.

Although children with at least 5 nits within 1 cm of the scalp were significantly more likely to develop an infestation than were those with fewer nits (32% vs 7%), only one-third of the children at higher risk converted to having an active infestation. School exclusion of children with nits alone would have resulted in many of these children missing school unnecessarily. In addition, head lice infestations have been shown to have low contagion in classrooms.[79] The results of several descriptive studies have suggested that education of parents in diagnosing and managing head lice may be helpful.[80–83] Parents can be encouraged to check their children's heads for lice regularly and if the child is symptomatic. School screenings do not take the place of these more careful parental checks.[13,84–86] It may be helpful for the school nurse or other trained person to check a specific student's head if he or she is demonstrating symptoms.

Management on the Day of Diagnosis

Because a child with an active head lice infestation likely has had the infestation for 1 month or more by the time it is discovered and poses little risk to others from the infestation, he or she should remain in class, but be discouraged from close direct head contact with others. If head lice is diagnosed in a child, confidentiality is important. The child's parent or guardian may be notified that day by telephone or by having a note sent home with the child at the end of the school day stating that prompt, proper treatment of this condition is in the best interest of the child and his or her classmates. Common sense and calm should prevail within a school when deciding how "contagious" an individual child may be (a child with hundreds versus a child with 2 live lice). It may be prudent to check other children who are symptomatic or who were most likely to have had direct head-to-head contact with the infested child. Some experts argue that because of the relatively high prevalence of head lice in young school-aged children, it may make more sense to alert parents only if a high percentage of children in a classroom are infested. Other experts feel strongly that these "alert letters" violate privacy laws, cause unnecessary public alarm, and reinforce the notion that a head lice infestation indicates a failure on the school's part rather than a community problem.[85] However, studies examining the efficacy of alert letters are not available;

consequently, some schools choose to design guidelines that they believe best meet the needs of their student population, understanding that although a head lice infestation may not pose a public health risk, it may create a public relations dilemma for a school.

Criteria for Return to School

A child should not be restricted from school attendance because of lice, because head lice have low contagion within classrooms.[79] "No-nit" policies that exclude children until all nits are removed may violate a child's civil liberties and are best addressed with legal counsel for schools. However, most health care professionals who care for children agree that no-nit policies should be abandoned.[85] International guidelines established in 2007 for the effective control of head lice infestations stated that no-nit policies are unjust and should be discontinued, because they are based on misinformation rather than objective science.[86] The American Academy of Pediatrics and the National Association of School Nurses[87] discourage no-nit policies that exclude children from school. However, nit removal may decrease diagnostic confusion, decrease the possibility of unnecessary retreatment, and help to decrease the small risk of self-reinfestation and social stigmatization.

A school nurse familiar with lice infestations, if present, can perform a valuable service by rechecking a child's head if requested to do so by a parent. In addition, the school nurse can offer extra help to families of children who are repeatedly or chronically infested. In rare instances, it may be helpful to make home visits or involve public health nurses if there is concern about whether treatment is being conducted effectively. Parent education by school health professionals can reinforce similar goals for the medical home.

SUMMARY OF KEY POINTS

1. No healthy child should be excluded from school or allowed to miss school time because of head lice or nits. Pediatricians may educate school communities that no-nit policies for return to school should be abandoned.
2. It is useful for pediatricians to be knowledgeable about head lice infestations and treatments (pediculicide and alternative therapies); they may take an active role as information resources for families, schools, and other community agencies.
3. Unless resistance to these products has been proven in the community, 1% permethrin or pyrethrins are a reasonable first choice for primary treatment of active infestations if pediculicide therapy is required.
4. Carefully communicated instructions on the proper use of products are important. Because current products are not completely ovicidal, applying the product at least twice, at proper intervals, is indicated if permethrin or pyrethrin products are used or if live lice are seen after prescription therapy per manufacturer's guidelines. Manual removal of nits immediately after treatment with a pediculicide is not necessary to prevent spread. In the school setting, nit removal may be considered to decrease diagnostic confusion and social stigmatization.
5. If resistance to available OTC products has been proven in the community, if the patient is too young, or if parents do not wish to use a pediculicide, consider the manual removal of lice/nits by methods such as "wet-combing" or an occlusive method (such as petroleum jelly or Cetaphil cleanser), with emphasis on careful technique, close surveillance, and repeating for at least 3 weekly cycles.
6. Benzyl alcohol 5% can be used for children older than 6 months, or malathion 0.5% can be used for children 2 years or older in areas where resistance to permethrin or pyrethrins has been demonstrated or for a patient with a documented infestation that has failed to respond to appropriately administered therapy with permethrin or pyrethrins. Spinosad and topical ivermectin are newer preparations that might prove helpful in difficult cases, but the cost of these preparations should be taken into account by the prescriber (Table 1).
7. New products should be evaluated for safety and effectiveness.
8. School personnel involved in detection of head lice infestation should be appropriately trained. The importance and difficulty of correctly diagnosing an active head lice infestation should be emphasized.
9. Head lice screening programs have not been proven to have a significant effect over time on the incidence of head lice in the school setting and are not cost-effective. Parent education programs may be helpful in the management of head lice in the school setting.

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ERRATA

Mellon et al. Should All Deaf Children Learn Sign Language? Pediatrics. 2015;136(1):170–176

Errors occurred in the article by Nancy K. Mellon et al, titled "Should All Deaf Children Learn Sign Language?" published in the July 2015 issue of *Pediatrics* (2015;136[1]):170–176; doi:10.1542/2014-1632).

On page 170, in the list of authors, the first author should have been Donna Jo Naploli. The corrected list of authors should have read: Donna Jo Napoli, PhD[a], Nancy K. Mellon, MS[b], John K. Niparko, MD[c], Christian Rathmann, PhD[d], Gaurav Mathur, PhD[e], Tom Humphries, PhD[f], Theresa Handley, BA[a], Sasha Scambler, PhD[g], and John D. Lantos, MD[h]

The updated list of author affiliations should have read: [a]Swarthmore College; [b]The River School, Washington, District of Columbia; [c]Department of Otolaryngology, University of Southern California; [d]Institute for German Sign Language and Communication of the Deaf, University of Hamburg; [e]Graduate School, Gallaudet University; [f]Department of Education Studies, University of California at San Diego; [g]King's College London; and [h]Children's Mercy Hospital

Also on page 170, the abstract appeared as follows: "Every year, 10 000 infants are born in the United States with sensorineural deafness. Deaf children of hearing (and nonsigning) parents are unique among all children in the world in that they cannot easily or naturally learn the language that their parents speak. These parents face tough choices. Should they seek a cochlear implant for their child? If so, should they also learn to sign? As pediatricians, we need to help parents understand the risks and benefits of different approaches to parent–child communication when the child is deaf. The benefits of learning sign language clearly outweigh the risks. For parents and families who are willing and able, this approach seems clearly preferable to an approach that focuses solely on oral communication."

This should have read: "Every year, 10 000 infants are born in the United States with sensorineural deafness. Deaf children of hearing (and nonsigning) parents are unique among all children in the world in that they cannot easily or naturally learn the language that their parents speak. These parents face tough choices. Should they seek a cochlear implant for their child? If so, should they also learn to sign? As pediatricians, we need to help parents understand the risks and benefits of different approaches to parent–child communication when the child is deaf."

doi:10.1542/peds.2015-2443

Devore CD, Schutze GE; AAP, Council on School Health, Committee on Infectious Dises. Head Lice. *Pediatrics*. 2015;135(5):e1355–e1365

Three clarifications are issued for the following American Academy of Pediatrics clinical report, titled "Head Lice" published in the May 2015 issue of *Pediatrics*. 2015;135(5):e1355–e1365.

1. On page e1358, in the section on Malathion (0.5%), the second-to-last sentence should have read: "Safety and effectiveness of malathion lotion have not been established in children younger than 6 years, and the product is not recommended." (instead of "…the product is contraindicated").

2. On page e1358, in the section on Spinosad (0.9% Suspension), the second sentence should have read: "It is not recommended for children younger than 6 months because it also contains benzyl alcohol." (instead of "It is contraindicated…").

3. On page e1358, in the section on Spinosad (0.9% Suspension), the last sentence, which read, "Safety in children younger than 4 years has not been established." should have been deleted.

doi:10.1542/peds.2015-2696

Campbell et al. Critical Elements in the Medical Evaluation of Suspected Child Physical Abuse. *Pediatrics*. 2015;136(1):35–43

An error occurred in the article by Campbell et al, titled "Critical Elements in the Medical Evaluation of Suspected Child Physical Abuse" published in the July 2015 issue of *Pediatrics* (2015;136[1]:35–43; doi:10.1542/peds.2014-4192). On page 41, in Table 2, under "Radiology" and "Skull Fracture," this reads: "Head CT,[a] skeletal survey[a]." This text should have read: "Head CT,[b] skeletal survey[b]" (footnotes were incorrectly assigned).

doi:10.1542/peds.2015-2823

Ralston SL, Lieberthal AS, Meissner HC, et al. Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis. *Pediatrics*. 2014;134 (5):e1474–e1502

An error occurred in the American Academy of Pediatrics article, titled "Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis published in the November 2014 issue of *Pediatrics* (2014;134[5]:e1474–e1502). On page e1484, in the discussion after Key Action Statement 6b, in the fifth paragraph, the sentence reading "In 1 study of 64 healthy infants between 2 weeks and 6 months of age, 60% of these infants exhibited a transient oxygen desaturation below 90%, to values as low as 83%." should have been attributed to reference 104 (Hunt CE et al) instead of 105.

doi:10.1542/peds.2015-2862

Kurowski et al. Online Problem-Solving Therapy for Executive Dysfuntion After Child Traumatic Brain Injury. *Pediatrics*. 2013;132(1):e158–e166

An error occurred in the article by Kurowski et al, titled "Online Problem-Solving Therapy for Executive Dysfunction After Child Traumatic Brain Injury" published in the July 2013 issue of *Pediatrics* (2013;132[1]:e158–e166; doi: 10.1542/peds.2012-4040). On page e163, under the Results section, in Tables 3 and 4, the baseline and 6 month

TABLE 3 Improvements From Baseline to Follow-up on the Global Executive Composite (GEC) in the CAPS Versus IRC Treatments in the Entire Sample Older Teens (9th–12th Grade) and Younger Teens (6th–8th Grade)

	CAPS (n = 57)			IRC (n = 62[a])			F (df)	P[b]
	Mean (SD)			Mean (SD)				
	Baseline	6 Month	Change	Baseline	6 Month	Change		
Entire Sample[a]	58.53 (10.11)	57.00 (11.40)	−1.53 (8.75)	61.56 (10.74)	60.16 (12.16)	−1.40 (7.43)	0.17 (118)	0.68
Older Teens[a]	60.15 (10.51)	55.37 (11.44)	−4.78 (6.66)	61.54 (10.98)	60.69 (10.94)	−0.86 (5.98)	6.74 (61)	0.01
Younger Teens	57.07 (9.69)	58.47 (11.37)	1.40 (9.46)	61.59 (10.63)	59.48 (13.77)	−2.11 (9.06)	1.27 (56)	0.27

CAPS = Counselor Assisted Problem Solving, IRC = Internet Resource Comparison

[a] The total study participants for IRC was 63; however, one participant did not completed the Behavioral Rating Inventory (BRIEF)-Behavioral Regulation Index (BRI) Inhibit subscale, so the GEC could not calculated for this participant and they were excluded from this analysis.

[b] P values apply to differences between CAPS and IRC groups as measured by general linear models after controlling for baseline scores.

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