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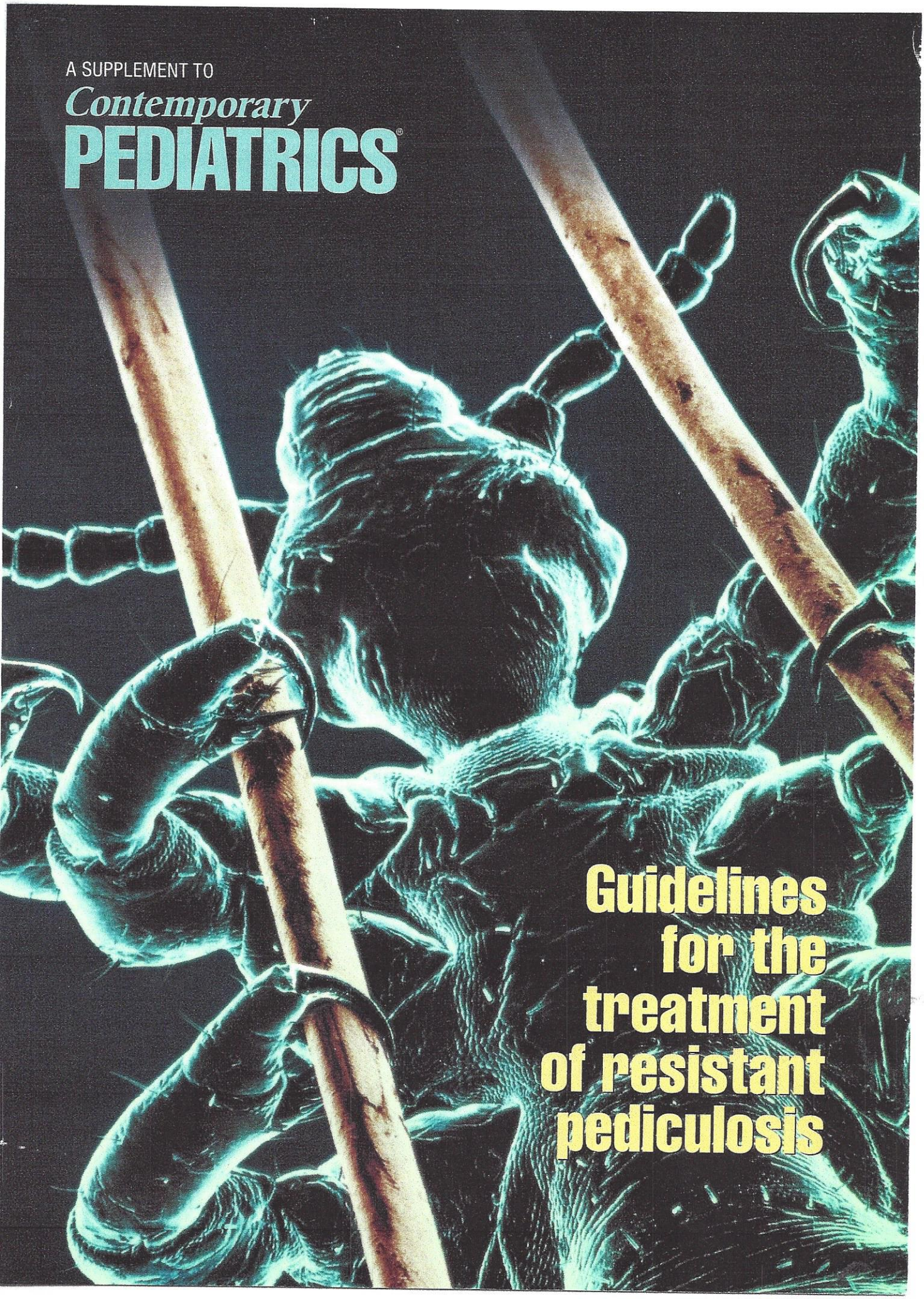

Guidelines for the treatment of resistant pediculosis

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Guidelines for the treatment of resistant pediculosis

By Ronald C. Hansen, MD, and colleagues from the Working Group on the Treatment of Resistant Pediculosis

Facing emerging reports of treatment-resistant lice, clinicians may benefit from an update and reinforcement of effective management guidelines for themselves and for parents. Representatives from the areas of public health, entomology, epidemiology, immunology, infectious disease, pediatrics, and dermatology explain the best approach to take.

Clinical studies and anecdotal evidence from around the globe support the emergence of lice that are resistant to specific pediculicides.[1–8] In the United States, for example, scientific studies document growing resistance to permethrin and lindane.[1,2] Although an informal survey of pharmacists conducted by the American Pharmaceutical Association revealed that an overwhelming majority (82%) recommend permethrin treatments for their customers, Pollack and colleagues demonstrated that some lice are strongly resistant to permethrin, regardless of the dose or frequency of application (Figure 1).[2] Pollack et al compared the effects of increasing concentrations of permethrin on lice in children from the United States and Sabah (Malaysian Borneo). The authors concluded, "Repeated applications or the use of more concentrated pyrethroid formulations are ill-advised, because those US head lice that are insusceptible to permethrin seem solidly resistant, regardless of dose."[2]

Inaccurate diagnoses and overuse or inappropriate use of pediculicides may be fueling this increase in resistant lice.[2] For example, cases are known of students with dandruff who have been treated multiple times for supposed louse infestations.[2,8] In addition, parents may treat children who have desiccated nits, although these dead, empty nit shells pose no threat of hatching or reproducing.[1,2] Also, overanxious parents, upon learning that louse infestations are present in their children's schools, may be applying pediculicides prophylactically (Table 1). In turn, treatment-resistant lice can lead to the use of drastic measures; desperate or ill-informed parents may resort to unproven or dangerous therapies to rid their children of lice.[1,2]

TABLE 1

Factors that contribute to resistance

Inappropriate use of pediculicides in non-lice cases (dandruff, pseudonits)

Overuse of over-the-counter treatments on nonviable nits or dead lice

Misuse of pediculicides (not following product instructions)

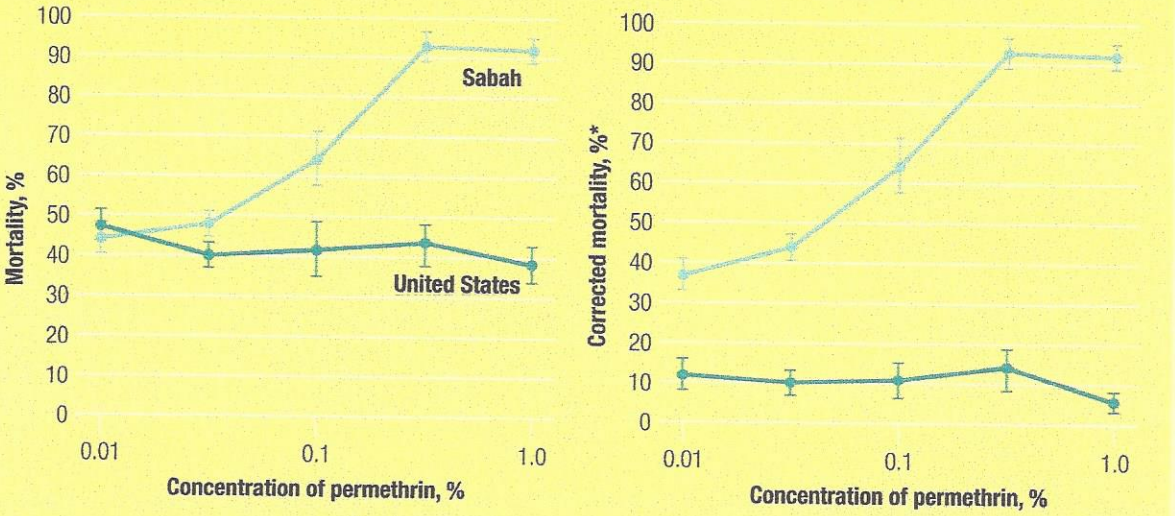
Use as prophylaxis

The combination of treatment-resistant lice and "no-nit" policies can lead to frustration for parents, health-care professionals, and schools. A "no-nit" policy dictates that children who have experienced louse infestations may not return to the classroom until they are louse- and nit-free. According to informal estimates from the National Association of School Nurses, as many as 90% of schools maintain "no-nit" policies. Compounding the problem is that most head louse infestations occur in young, school-age children; conservative estimates of the incidence of head lice are more than 6 million Americans annually.[8–10]

With "no-nit" policies, children are unable to attend school, despite a lack of scientific data to suggest that head lice cause disease.[1] Published reports and anecdotal

FIGURE 1

Documented resistance to permethrin



Source: Pollack RJ et al.[2] Reproduced by permission
*Data corrected for nonspecific mortality

Measuring the percentage of lice killed after exposure to increasing concentrations of permethrin demonstrates that US head lice are less susceptible to permethrin than Sabah (Borneo) lice, regardless of dose.

cases demonstrate that individual students may miss as much as 30 days to two months of school because of this policy.[1] The ostracism is compounded by the social stigma in the US regarding head lice.[2]

Furthermore, if children are not at school, one parent may not be able to work. Informal estimates from the Centers for Disease Control and Prevention show that parents' lost work time due to head louse infestations costs more than $1 billion annually, not including costs associated with the time spent by school nurses and administrators screening students for head louse infestations and addressing parental concerns. Interestingly, it has been noted that louse infestations are more likely to occur at home than at school, and "no-nit" policies have not ended the spread of louse infestations.[1] These factors and issues support the need for head louse management guidelines.

Making the diagnosis

Although parents or teachers may be the first to notice possible louse infestations, health-care professionals should confirm the diagnosis. Positive diagnosis is essential to avoid indiscriminate use of therapies, which can lead to resistance. (See "Differential diagnosis.") Most infestations in school-age children are asymptomatic; pruritus is the primary symptom when cases of infestation are symptomatic.[1] Depending on how sensitized the child is and previous exposure, sites of lice feeding may produce small erythematous macules, papules, or acute hive-like reactions. Secondary bacterial infections may occur but are not common. Because lice are more active at night than in the day, the child may experience sleeplessness.[1]

Use of a metal lice comb and a magnifying glass under bright,

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These guidelines are the opinions of the Working Group only. Please consult the full prescribing information before recommending any prescription product.

Differential diagnosis

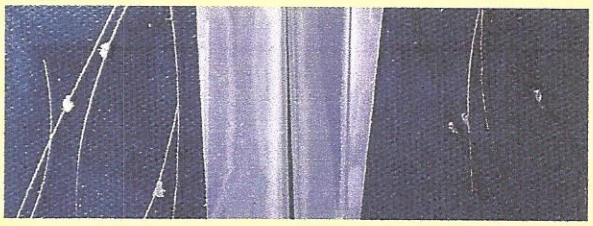
To eliminate the unnecessary use of pediculicides, pediatricians and other health-care professionals must differentiate carefully between louse infestation and conditions that may mimic it. Misdiagnosis may include other insects, dandruff, hairspray or gel droplets, insect bites, scabs, and dirt. Certain dermatologic conditions, such as seborrheic dermatitis, eczema, psoriasis, and piedra, also are commonly mistaken for pediculosis.

Definitive diagnosis can be made upon detection of live lice or viable nits on a child's head. Dead lice do not confirm a diagnosis. Likewise, lice must not be confused with other insects, such as aphids, that may blow into a child's hair. Thus, it is important for the practitioner to be able to recognize a louse.

Lice are ectoparasites. They are wingless insects with claws for grasping and chitinous mouths for piercing the scalp to feed on human blood. Adult lice measure approximately 2.1 to 3.3 mm, about the size of a sesame seed (see table). Because lice tend to adapt their color to their surroundings, red or black lice are more often found on people with dark hair and skin, and gray-white lice tend to infest those with light hair and complexions.

Viable nits, or eggs, are silvery-white, about 0.8 mm long, and shaped like tiny teardrops. With strong magnification, the developing nymph can be seen inside the egg. Nits often are found at the nape of the neck or behind the ears. They adhere firmly and eccentrically to the hair shaft, typically about $\frac{1}{4}$ inch from the scalp. In warmer climates and during the summer, viable nits can be found further down the hair shaft—as much as 6 inches or more. In cooler climates, however, nits that are more than $\frac{1}{2}$ inches from the scalp usually have hatched. Empty nit shells are nearly transparent, pose no threat, and do not require treatment.

Although lice and nits are difficult to find, a strong light, a x10 magnifying glass and a fine-toothed, metal nit comb can assist the health-care professional in differentiating between nits and artifact. Pseudonits or "hair muffs" are commonly mistaken for nits, because their size and color are similar (see figure). Pseudonits are desquamated epithelial cells. They encircle the hair shaft, and unlike nits, can be removed with gentle traction. Excessive use of pediculicides can dry the scalp and exacerbate the condition.



Courtesy of Elaine C. Siegfried, MD

A view magnified two times shows hair muffs ("pseudonits") on the left and lice nits on the right. The nits are smaller than the pseudonits, have a characteristic uniform goblet shape, and are attached eccentrically to the shaft.

Some hair infections also may be confused with pediculosis. Scalp infection with *Trichophyton tonsurans* can cause a minimally inflammatory, dandruff-like change in children, especially African-Americans. Fortunately, head louse infestations are much less common in this group than in others, but the scaly flakes can be readily mistaken for nit shells. The yeast, *Trichosporon beigelii*, causes white piedra, which resemble dead or hatched nits. Black piedra, caused by *Piedraia hortae*, may be mistaken for viable nits. Furthermore, hair spray and gel residue may resemble nits. However, residue from hair products slides easily off the hair, while nits are cemented to the hair shaft.

By distinguishing between artifact and other false positives, pediatricians and other health-care professionals can make an accurate diagnosis of active louse infestation. If there is such an infestation, appropriate pediculicide treatment can be initiated. If not, excessive or unnecessary pediculicide use can be avoided, and this may help to avert pediculicidal resistance.

Characteristics of *Pediculus humanus capitis*

Habitat	Head
Size of louse	
Female	2.4–3.3 mm
Male	2.1–2.6 mm
Size of nit	0.8 mm
Egg incubation period	10–12 d
Nymphal stages	
First stage	3–4 d
Second stage	3–4 d
Third stage	3–4 d
Adult female to gravid female	0.5–2 d
Egg to adult	17–25 d
Adult longevity	23–30 d
Total egg output	110–140
Survival away from host	6–26 h
Adult mobility (cm/min)	6–30

Source: Adapted from Meinking TL: *Curr Probl Dermatol* 1999;11:73. Reproduced by permission

natural light may help to screen for nits and lice and confirm the diagnosis (Figures 2 and 3).[1,2,10] To effectively remove nits, a lice comb must have an intertooth space that is smaller than the width of a single nit.[10] Metal combs are preferred because they are less likely to bend when combing through hair, and they can be sterilized. If one member of the family is infested, all other family members and close contacts should be examined.[1]

Mass screenings are disruptive and not warranted, however. They increase the potential for lice phobia and prophylactic use of pediculicides. Likewise, classroom or school-wide notifications may increase public alarm, bring undue attention to the children infested with lice, and also disrupt school productivity. Furthermore, to prevent the injudicious use of pesticides on unaffected schoolmates, only parents of infested children should be notified if louse infestation is confirmed.

Lice generally are transmitted by direct head-to-head contact.[1] Therefore, transmission is more likely to occur in the home than in school. Lice do not jump or fly, nor do they typically survive off their human host beyond 24 hours.[1] There is little evidence that exclusion from school reduces transmission of lice. No other minor medical condition warrants school exclusion. Conversely, children with morbid, communicable disorders (such as a viral upper respiratory infection or tinea capitis) are routinely allowed to attend school. Therefore, confirmation of louse infestation does not warrant being kept out of school but does require treatment. The National Association of School Nurses recently agreed to phase out school exclusion for head louse infestation (see www.nasn.org/issues/nitfree.htm).

Misuse or misunderstanding of how to use the pediculicide can lead to persistent infection, eventual resistance, or injury.

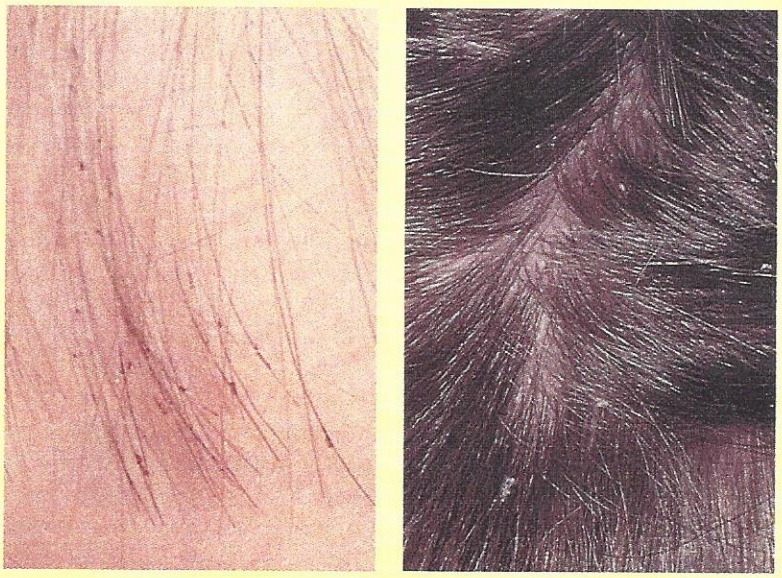
Management strategies

Guidelines for treating louse infestations have been established. These guidelines address the initial treatment plan, a plan for treatment failure, and recommendations and warnings on alternative treatment options.

First-line therapy is to use over-the-counter (OTC) products approved by the Food and Drug Administration (FDA), primarily synergized pyrethrins or permethrin-based agents. However, if infested children live in a region of the country where resistance seems to be occurring, parents should be advised to consult a physician or other prescribing practitioner for a prescription product.

To reduce the potential for product misuse, physicians, pharmacists, and other health-care professionals should stress to parents the importance of adhering to the instructions on the package insert.

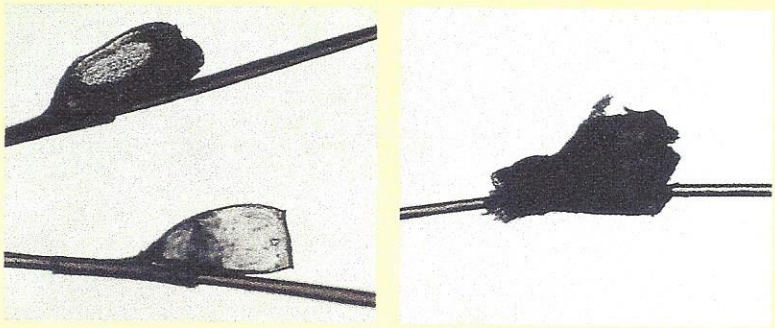
FIGURE 2



In this magnified view, live nits camouflaged with matching pigment can be easily seen against lighter skin at the back of the neck (left). Pseudonits are bits of desquamated follicular infundibulum that encircle the hair shaft (right). Unlike true nits, they are easily removed and irregular in shape.

Courtesy of Elaine C. Siegfried, MD

FIGURE 3



Courtesy of Elaine C. Siegfried, MD

A viable nit (top left) at ×40 magnification and an empty nit casing (bottom left) can be compared with a pseudonit (right), which surrounds the hair (eccentric attachment), unlike true nits.

Misuse or misunderstanding of how to use the pediculicide can lead to persistent infestation, eventual resistance, or injury. Because pediculicides may not be 100% ovicidal, it also is important to emphasize the use of an effective metal lice comb to remove nits and dead lice.

Eight to 10 days after the initial treatment, a second treatment using the same OTC formulation is recommended to ensure that nits are killed after hatching.[1] After another eight- to 10-day period, the patient should be re-examined. If live lice are detected, the treatment probably has failed. It is important that parents contact a prescribing health-care practitioner to verify treatment failure and initiate second-line therapy.

Second-line therapy: responding to OTC treatment failure. Treatment failure may be attributed to:

- Inappropriate use of the product
- Ovicidal failure of the product
- Resistance to the pediculicide
- Reinfestation from another source.

If live lice are present after two OTC treatments, second-line therapy with a prescription pediculicide is warranted. Malathion lotion 0.5% in conjunction with nit combing is recommended.[4,11] If necessary, a second treatment with malathion lotion can be applied seven to nine days after initial treatment.

The malathion lotion package labeling and instructions should be thoroughly reviewed with parents or guardians to assure complete understanding. They should be reminded that this agent is flammable, and precautions must be taken to ensure that the child is not exposed to electric heat sources or an open flame, including cigarettes. As with all pediculicides, care should be taken to avoid contact with the eyes and mouth.

Although lindane 1% may be thought of as a second-line therapy, it should be considered a "last resort" due to its possible lower efficacy and potential for neurotoxicity if misused.[1,4,11–14] (See "Lindane resistance and efficacy.")

Alternative treatments. Frustration about treatment failures or concern about pediculicides may push parents to seek alternative treatments; only products with an FDA–approved indication for treatment of head lice are advised, however. Although oral ivermectin and trimethoprim-sulfamethoxazole are suggested as treatment by some, systemic therapy for ectoparasitic infestations is not recommended. Mayonnaise, petrolatum, olive oil, and mineral oil have not been adequately studied; hence, their efficacy against head lice and nits is unknown.[1] More important, the use of kerosene, gasoline, paint thinners, turpentine, or industrial or garden pesticides is dangerous and should be avoided.[1]

Some parents may consider lice combs as substitutes for pediculicides. To be effective by themselves in eliminating infestations, however, lice combs must be used repeatedly until all lice and nits are removed. Realistically, many families cannot dedicate the tremendous amount of time necessary to remove louse infestations with combs; hence, the lice comb should be used in conjunction with a pediculicide.

Controlling the home environment

Excessive housecleaning is not necessary because lice rarely live off the human host longer than a day. Routine cleaning is recommended, however. It should include washing recently used clothes, towels, and bedding in hot water at 130° F or drying on high heat. Stuffed animals do not need to be placed in plastic bags for several weeks to kill lice or nits. However, if the child sleeps with a specific stuffed animal or blanket, thorough washing in hot water (130° F) or high-heat drying is adequate. Parents should clean the child's combs, brushes, and other hair care accessories (such

The facts on head lice

Most head louse infestations occur in school-age children; estimates of the incidence are more than 6 million Americans per year.

Although parents or teachers may first see evidence of lice, a health-care professional should confirm the diagnosis.

A lice comb, a special tool available at drugstores or through the Internet, and a magnifying glass may help confirm the diagnosis.

How did my child get lice?

Transmission of lice generally occurs with direct head-to-head contact, possibly with a close friend or sibling. Transmission is more likely to occur in the home than in the school.

Lice do not jump or fly, and they rarely survive off a human host more than a day.

What are the symptoms?

Many louse infestations experienced by school-children are not associated with symptoms but if symptoms do occur, your child's head may itch.

You may see red, hive-like bumps on the head. Lice are active at night so your child may have trouble sleeping. A louse infestation generally does not lead to infection.

How do I treat this condition?

Use of an over-the-counter (OTC) product is the first step in treatment. If your child lives in an area where resistance seems to be occurring, the doctor may recommend treatment with a prescription product, such as malathion 0.5%.

Whether using an OTC or prescription product, it is very important to follow any instructions that are included with the product.

After using the product, a metal nit comb also should be used to remove dead lice and nits.

Repeat the treatment with the OTC product eight to 10 days after the first application. A health-care professional should re-examine the child's head after another eight to 10 days.

If live lice are still seen, treatment failure likely has occurred. A health-care professional will advise you to use a prescription product.

What else do I need to know?

Smothering lice with mayonnaise, petrolatum, olive oil, or mineral oil is not recommended. These approaches have not been adequately studied.

It is especially important to avoid using dangerous materials such as kerosene, gasoline, paint thinners, or turpentine to get rid of lice.

It is very difficult (and time-consuming) to eliminate an infestation of lice with use of a lice comb alone. The comb should be used along with an OTC or prescription product.

Excessive cleanup in the home—that is, major scrubbing of all surfaces and items in a room—is not necessary but the child's clothes, towels, and bedding should be washed in hot water (130° F) or dried on high heat. The same can be done for the child's toys or blanket or with items used in the child's hair (combs, brushes, hair clips).

Do not use an insecticide on furniture, rugs, or pets.

Lindane resistance and efficacy

Clinicians can suspect the emergence of resistant lice when the products that reliably treated pediculosis a decade ago now seem ineffective. Because resistance can vary greatly from one region to another, practitioners often must rely on anecdotal feedback from other physicians, nurses, and pharmacists to determine whether resistance has developed in a given area. To complicate matters, sensitive and resistant lice frequently coexist, making absolute determination of resistance much more difficult.

Lindane is one pediculicide to which head lice appear to have become resistant. Reports of lindane-resistant head lice began emerging as early as the 1970s.[1] Brown et al noted that lindane resistance now occurs throughout the world, including the United States.[15] In the 1980s, researchers found that lindane was effective in some cases, but not others. Four separate studies revealed that 14%, 15%, 57%, and 24% of subjects were infested with head lice two weeks after treatment with 1% lindane shampoo.[16–20]

The prevalence of these lindane-resistant lice seems to correlate with areas where lindane-containing products were extensively used.[15] This is consistent with the opinion of the Working Group on the Treatment of Resistant Pediculosis that overuse of a pediculicide may contribute to the emergence of resistance to the product's active ingredient. In addition, Meinking et al noted that 1% lindane shampoo was only 70% ovicidal, and it was the slowest-acting pediculicide, requiring approximately three hours to kill lice.[11] In fact, the authors of a 1995 systematic review of 28 head lice studies questioned whether the use of lindane for the treatment of *Pediculus humanus capitis* was justified.[20]

Resistance and efficacy issues aside, lindane has been reported to cause central nervous system toxicity, including seizures, after increased dermal contact and misuse, such as inadvertent oral ingestion.[15, 21–24] The panel concluded, therefore, that though lindane 1% may be thought of as a second-line therapy, it should be considered a "last resort" due to its possible lower efficacy and potential for neurotoxicity if misused.

as hairpins or clips) in hot water. These items should not be shared. Spraying an insecticide on furniture, rugs, or pets is not recommended.

Spreading the word

Health-care professionals should try to educate families in their communities about lice:

- The facts and myths surrounding louse infestation
- Appropriate use of pediculicides
- Use of lice combs
- The value of screening all family members, if one member is infested
- The importance of not isolating the infested child or excluding the child from school.

The last word

Several factors are playing a role in the emergence of treatment-resistant lice, including inaccurate diagnosis and overuse or misuse of pediculicides. By following specific management guidelines, health-care professionals, working with families, can diagnose, treat, and manage louse infestation at home, at school, and within the community. □

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