Head Lice Infestations: Counseling Your Patients

Dr. Thomas A. Gossel and Dr. J. Richard Wuest have no relevant financial relationships to disclose.

**Goal.** The goal of this lesson is to review head lice infestations and their management, with emphasis on key points of information to pass along to patients.

**Objectives.** At the conclusion of this lesson, successful participants should be able to:

1. recognize the cause and triggers, epidemiology and prevalence, pathogenesis, and clinical impressions of head lice infestations;
2. demonstrate an understanding of the mechanism of action and major adverse events associated with the drugs used in treating head lice infestations;
3. select nonpharmacologic measures that are reported to control head lice infestations; and
4. exhibit knowledge of information relative to the prevention and management of head lice infestations to convey to patients and/or their caregivers.

Head lice infestation has been known since antiquity. Described in ancient Egyptian and Greek medical texts, head lice have been a source of irritation and disgust for thousands of years. Its prevalence is not known today, since the reporting of infestations is not mandatory. The U.S. Centers for Disease Control and Prevention (CDC) estimates that six to 12 million infestations occur each year in the United States. Health authorities report that the number of cases is increasing each year, primarily because of emerging treatment resistance. Infestations have annual combined direct and indirect costs in the United States estimated to be as high as $1 billion.

Although head lice are not vectors of human disease, and therefore pose no significant health risk, their presence can lead to substantial psychological frustration, discomfort, parental anxiety, embarrassment for both children and parents, and unnecessary absence from school and work. Preventive and therapeutic practices, along with the “no-nit” policy of excluding infested children from school, can also induce significant social stress.

**Head Lice**

The insects are *ectoparasites* of humans, that is, they live on the surface of the host’s body. An infestation of lice is termed *pediculosis*. A *pediculicide* is an agent that kills lice.

Head lice appear as tiny yellow-brown to dark gray “spots” measuring approximately 1 to 3 mm in length, about the size of a sesame seed. Their physical features cannot be distinguished by the unaided eye, but can be viewed with ease with a strong magnifying glass in good lighting. Insects are elongated and flat with three pairs of clawed legs adapted for grasping hair shafts for stability when feeding. Their cylindrical shape enables them to move freely among dense hair growth. The insects live in the hair of the scalp and neck and are not usually found elsewhere on the body. Mature lice are wingless. They neither hop, jump nor fly from one individual to another, although there are reports that combing dry hair can build up sufficient static electricity to physically eject an adult louse from an infested scalp.

Lice breathe through seven pairs of spiracles, one pair on the thorax and six on the abdomen. These spiracles can open and close in response to wetting and may remain closed for up to 12 hours without injury to the insect.

The blood-sucking insects depend solely upon human blood for nutrition; thus, they are *hematophagous*. Their saliva contains an anticoagulant that is introduced under the skin of the infested host during feeding, which prolongs their feeding period; lice may remain attached to the same site for several days while they continue...
to feed, generally every four to six hours. Head lice engorged with blood may appear reddish-brown in color. In most climates, they survive only 15 to 20 hours off the host.

Head lice are transmitted primarily by direct contact with an infested person. Outbreaks occur in greater numbers in August, then increase significantly when schools reopen, and continue to increase with onset of autumn. Infestation occurs primarily in children at all elementary grade levels and whenever children assemble, and in communal living conditions. Members of households with infested children are also at risk.

Infestation may also be acquired by direct contact with the head of an infested person, commonly during play. Infestations are twice as common in girls than in boys, perhaps due to their greater willingness than boys to share personal hair-grooming aids. Hair length or frequency of shampooing are not important criteria.

**Lice infestations are widespread throughout the world and discriminate neither on socioeconomic status nor personal hygiene. Caucasians are infested more often than non-Caucasians, perhaps because of African-Americans’ greater use of pomades and the characteristics of lice that make them better adapted to grasp the more cylindrical hair shafts of Caucasians.**

**Eggs.** Lice eggs, or their empty egg casings (nits) are small, spherical or oval protrusions about the size of the period at the end of this sentence. Nits appear translucent; after hatching in seven to 10 days, they appear initially as yellowish-white spots that are bonded firmly onto the hair shaft by a sticky substance secreted by the female insect. Bonding is strong enough to protect nits from being dislodged by ordinary washing or combing. Each female louse can produce approximately five to six eggs daily over her 30 to 35 day lifespan. A typical infestation may involve 10 to 30 adult lice at any one time but the range is large. Juvenile lice (nymphs) take about six to 10 days to grow into adulthood. Nymphs will molt three times as they transform into sexually mature adults.

**Clinical Manifestations**

Itching is the principal symptom, appearing in response to histamine and other inflammatory substances including the proteinaceous salivary secretion released following the insect’s bite. Itching may persist a week or longer, even after the lice have been eradicated.

Bite reactions are classified into four phases: phase I is noted by lack of clinical symptoms; phase II entails papules (small elevations of the skin) with moderate itching; phase III consists of wheals (smooth, slightly elevated dermal elevations, which are redder or paler than surrounding areas) immediately following a bite with subsequent delayed papules and intense itching; and phase IV is characterized by smaller papules with mild itching. The phases presumably are related to evolution of immune sensitivity and adherence. Notably, new bites may cause reactivation of older, healed bitten areas. An inflammatory reaction to lice saliva or anticoagulant has been suggested as the most likely cause of the bite reactions.

If lice infestation is not treated, intense itching with vigorous scratching may incite secondary bacterial or fungal infection. Impetigo and furunculosis (boils) may be outcomes. Uncommonly, in heavily infested and untreated patients, the hair can become tangled with exudates, predisposing the area to fungal infection, resulting in a malodorous mass. Countless lice and nits can be found under the entangled hair mass.

**Detection**

Most experts agree that before treatment begins, there must be positive identification of a live louse. Although itching and the presence of eggs or nits attached to the hair raises suspicion, only detection of a live louse confirms infestation. Dandruff, dried hairspray, lint, sand and hair casts,

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**Table 1: Patient information for head lice detection**

<table>
<thead>
<tr>
<th>Dry combing for detection</th>
<th>Wet combing for detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Straighten and untangle the dry hair using an ordinary comb.</td>
<td>1. Wash the hair in the normal way with ordinary shampoo.</td>
</tr>
<tr>
<td>2. Once the comb moves freely through the hair without dragging, switch to a fine-tooth comb.</td>
<td>2. Rinse out the shampoo and put on ordinary conditioner.</td>
</tr>
<tr>
<td>3. Comb the hair from the scalp down, being sure to raise the comb near the end of the hair so as not to miss detection of lice.</td>
<td>3. Comb the hair with a normal comb to untangle and straighten.</td>
</tr>
<tr>
<td>4. After each stroke, examine the teeth of the comb for living lice.</td>
<td>4. Place the teeth of the detection comb into the hair at the roots, so that the comb touches the scalp.</td>
</tr>
<tr>
<td>5. A magnifying glass will be helpful to distinguish lice and eggs from debris (e.g., dandruff).</td>
<td>5. Draw the detection comb through to the tips of the hair.</td>
</tr>
<tr>
<td>6. Continue combing the hair section by section until the whole head of hair is combed through.</td>
<td>6. Comb systematically working around the head.</td>
</tr>
<tr>
<td>7. Check the comb for lice after each stroke by wiping both sides on a tissue.</td>
<td>7. Check the comb for lice after each stroke by wiping both sides on a tissue.</td>
</tr>
<tr>
<td>8. After all the hair has been thoroughly combed, rinse out the conditioner.</td>
<td>8. After all the hair has been thoroughly combed, rinse out the conditioner.</td>
</tr>
<tr>
<td>9. While the hair is still wet, use an ordinary comb to untangle and straighten it again.</td>
<td>9. While the hair is still wet, use an ordinary comb to untangle and straighten it again.</td>
</tr>
<tr>
<td>10. Repeat detection combing in the rinsed hair to check for any lice which might have been missed the first time.</td>
<td>10. Repeat detection combing in the rinsed hair to check for any lice which might have been missed the first time.</td>
</tr>
</tbody>
</table>
which have all been mistaken for eggs and nits, are much more easily removed.

Detection is best achieved using a fine-tooth comb (spacing of teeth less than 0.3 mm) to systematically check all areas of the scalp and hair. Both dry and wet detection combing (Table 1) have been shown to be better for detecting head lice than simple direct visual inspection. Whether or not wet combing is better than dry combing remains controversial. The length of time required for each is largely dependent on hair length and density. A wet combing session will take longer, perhaps up to 30 minutes, than dry combing, up to five minutes if done properly.

Nits remain attached to hair shafts for as long as six months. Human hair grows at a rate of approximately 1 cm/month. As the hair grows, the bonded nits move away from the scalp. After two to three months, empty nits become more visible, especially on dark hair. Appearance of nits several months after a treatment can lead to a false-positive diagnosis of an active infestation because most people cannot differentiate between viable eggs and nits and assume that if eggs or nits are present the child must also have lice. Therefore, treatment is initiated.

**Treatment**
The goals of treatment are to kill the insects and their eggs, and control symptoms of infestation such as itching and secondary infection. When infestation is determined, every member of the household and all other close-contacts should be examined carefully and completely. An OTC antipruritic cream containing an antihistamine, local anesthetic or hydrocortisone may be applied topically and is usually sufficient to control itching. Severe itching may require stronger therapy or use of systemic antipruritics. Treatment of secondary infection includes topical application of an appropriate antibiotic or antifungal agent. Infections that fail to heal within seven days or worsen should be evaluated by a physician. Their treatment may require systemic anti-infectives.

Current guidelines still recommend use of OTC pediculicides in most cases, usually with a maximum of two applications. Physician involvement usually is recommended if lice are not eradicated after the first two attempts.

**Pyrethroids**

**Pyrethrins.** Commercial preparations of pyrethrins consist of a mixture of substances obtained from flowers of the plant *Chrysanthemum cinerariaefolium*. This mixture contains substances identified as esters of chrysanthemic acid and pyrethric acid, and three alcohols.

Pyrethrins (0.33 percent) in combination with piperonyl butoxide (4 percent) is a commonly used treatment for self-management of head lice. Piperonyl butoxide is included with pyrethrins because it potentiates the insecticide’s action, by suppressing the insect’s oxidative degradation mechanism. This combination of ingredients is, therefore, synergistic. Contact time with pyrethrins is prolonged and the kill rate is increased.

Pyrethrins kill insects by disrupting ion transport mechanisms at their nerve membranes. Affected insects experience convulsions, paralysis and death. None of the natural pyrethrins are completely ovicidal because developing insects within newly laid eggs lack a nervous system for the first four days. About 20 to 30 percent of eggs remain viable after the first treatment. Successful treatment requires reapplication seven to 10 days later to kill newly emerged nymphs hatched from eggs that survived.

Products (Table 2) containing pyrethrins/piperonyl butoxide are safe for human use when used correctly. The drugs are not absorbed appreciably following topical application. Small quantities that may enter the blood will be metabolized rapidly.

Although the rigorous testing currently required by FDA was not performed for pyrethrins when first marketed, systematic review of the safety of pyrethrins-containing products reveals only minor adverse reactions. Adverse effects are rare when products are used as directed, with contact dermatitis the most frequently reported affliction. Since pyrethrins are obtained from natural plant origin, allergic rhinitis, wheezing and coughing, and asthma attacks may be precipitated in individuals sensitive to ragweed. Inhaled pyrethrins may cause nausea and vomiting, and rarely, muscle paralysis and death. Most reports of clinical toxicity with synergized pyrethrins can be traced to solvents, typically petroleum distillates, in the preparation.

**Permethrin.** Permethrin is a synthetic pyrethroid that has been altered chemically to provide better stability with exposure to light and heat. It is believed to act by the same mechanism as pyrethrins. Aceticin (and others) 5 percent is marketed as a treatment for scabies, but not head lice. It has been used in an effort to overcome relative resistance to permethrin 1 percent. Unfortunately, permethrin-resistant lice may be resistant over a wide range of doses.

Permethrin has low toxicity in mammals since it is poorly absorbed and inactivated rapidly by ester hydrolysis. Like pyrethrins, permethrin is contraindicated in persons hypersensitive to chrysanthemums or synthetic pyrethroid. Adverse effects include temporary itching, burning, stinging, numbness and pain, but these are rare. Permethrin should not be used on infants because of the greater permeability of their skin, and their reduced ability to metabolize it.

Permethrin is retained on the hair after an initial application and thereby has “residual action” for two to three weeks, although retreatment at one week is still widely recommended. Currently, permethrin 1 percent is considered by many to be the preferred first-line treatment for head lice infestation.
Table 2

Agents for management of head lice

<table>
<thead>
<tr>
<th>Generic name</th>
<th>Dosage Form</th>
<th>Strength</th>
<th>Trade name</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permethrin</td>
<td>Liquid</td>
<td>1%</td>
<td>Nix, and generics</td>
<td>OTC</td>
</tr>
<tr>
<td></td>
<td>Spray</td>
<td>0.4%</td>
<td>Pronto</td>
<td>OTC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5%</td>
<td>A-200, RID</td>
<td>OTC</td>
</tr>
<tr>
<td>Pyrethrins with</td>
<td>Liquid</td>
<td>0.3%/2%</td>
<td>Tisit</td>
<td>OTC</td>
</tr>
<tr>
<td>piperonyl butoxide</td>
<td>Shampoo</td>
<td>0.3%/3%</td>
<td>Tisit</td>
<td>OTC</td>
</tr>
<tr>
<td></td>
<td>Gel</td>
<td>0.3%/3%</td>
<td>Tisit Blue,</td>
<td>OTC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Innogel Plus</td>
<td>OTC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A-200</td>
<td>OTC</td>
</tr>
<tr>
<td>Benzyl alcohol</td>
<td>Lotion</td>
<td>5%</td>
<td>Ulesfia</td>
<td>Rx</td>
</tr>
<tr>
<td>Lindane</td>
<td>Liquid</td>
<td>1%</td>
<td>generics</td>
<td>Rx</td>
</tr>
<tr>
<td></td>
<td>Shampoo</td>
<td>1%</td>
<td>generics</td>
<td>Rx</td>
</tr>
<tr>
<td>Malathion</td>
<td>Lotion</td>
<td>0.5%</td>
<td>Ovide</td>
<td>Rx</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>and generics</td>
<td>Rx</td>
</tr>
<tr>
<td>Spinosad</td>
<td>Suspension</td>
<td>0.9%</td>
<td>Natroba</td>
<td>Rx</td>
</tr>
</tbody>
</table>

Lindane
Lindane (y-benzene hexachloride) is an organochloride marketed in a 1 percent concentration liquid and shampoo. It is absorbed rapidly across the exoskeleton of insects. As a gamma-aminobutyric acid (GABA) inhibitor, and with neurotoxic properties similar to DDT, lindane causes excess CNS stimulation in, and ultimate death of, the ectoparasite. It has low ovicidal activity, and resistance has been reported worldwide for many years.

About 10 percent of topically applied lindane is absorbed. It concentrates in adipose tissue and the brain of humans. Small amounts may persist within the brain for up to two weeks following topical use. Absorption through the louse exoskeleton occurs much more efficiently than through human skin. Lindane is reported to cause CNS stimulation, nausea and vomiting, lethargy, disorientation, restlessness and convulsions in humans. Toxic symptoms are often the result of misuse of the product.

The use of lindane for treatment of lice or scabies was banned in California in 2002 due to concern about neurotoxicity and negative effects on the environment. It is available elsewhere by prescription only. Some would argue that this agent is seldom an appropriate choice since other, safer agents are available and the ovicidal effect of lindane appears to be inferior to that of other agents.

Malathion
This pediculicide (Ovide, and others) is an organophosphate (acetylcholinesterase inhibitor) insecticide that is safe and effective for treatment of head lice, and is ovicidal. Malathion causes respiratory paralysis in the arthropod by causing accumulation of acetylcholine at its nicotinic receptor sites. It is toxic within three seconds of application to both lice and their eggs.

Human toxicity is minimal when the product is used as directed because absorbed malathion is detoxified rapidly. Less than 10 percent of the drug applied to the skin is absorbed.

Benzyl Alcohol
One of the latest approvals to treat head lice is a lotion containing benzyl alcohol 5 percent in mineral oil (Ulesfia). Although benzyl alcohol is present in other products as an excipient, it has not previously been approved as a new drug. Lice exposed to benzyl alcohol lose the ability to close their respiratory spiracles. The lotion vehicle also obstructs their airways to cause asphyxiation. Benzyl alcohol is not ovicidal.

Benzyl alcohol is generally well tolerated, with eye irritation and contact dermatitis reported. Also reported is that preterm neonates injected intravenously with products containing benzyl alcohol have developed a “gasping syndrome” with CNS depression, metabolic acidosis and respiratory distress, sometimes progressing to neurological deterioration and cardiovascular collapse.

Spinosad
The newest pediculicide, spinosad (Natroba), is a nonsynthetic,
fermentation product of the bacterium, *Saccharopolyspora spinosa*, discovered in 1982 from soil in an abandoned rum distillery. The insecticide has been used on outdoor ornamentals, lawns, vegetables and fruit trees to control most insects.

Spinosad alters the function of nicotinic acid and GABA-gated ion channels in a manner consistent with the observed neuronal excitation. Spinosad does not interact with known binding sites for other nicotinic or GABA-ergic insecticides. These data indicate that spinosad acts through a unique insecticidal mechanism. After a period of hyperexcitation, lice become paralyzed and die, with death within one to two days following ingestion of the substance.

Spinosad is not acutely toxic to mammals and is nonhazardous by oral, dermal, ocular and inhalational routes. In long-term mammalian studies, it did not cause tumors, neurotoxicity, embryotoxicity, fetal toxicity or teratogenicity.

**Resistance**

With misdiagnosis of head lice and/or misuse of chemical pediculicides, the question of drug resistance has emerged as an important issue in recent years. Early studies showing that pyrethrins, permethrin and malathion were equally effective in treating head lice infestations may no longer be clinically relevant in communities with resistant lice. The current prevalence of resistance in the United States is therefore unknown. To slow the emergence of resistance, therapeutic agents can be rotated.

**Mechanical Removal**

Lice and nits can be effectively removed manually with a fine-tooth comb. They can also be picked off one by one using fingers or tweezers. While some sources may recommend that the hair be back-combed because of the angle of the attached nit relative to the hair shaft, it is recommended that the hair be combed outward from the scalp.

There is increased interest in treating head lice infestation by removing the insects and their eggs solely with combing, in part due to the emerging fear that lice are becoming increasingly resistant to chemical pediculicides, and as an alternative to pediculicides for children two years of age and younger. Moreover, the potential for toxicity when chemical pediculicides are misused has helped popularize the use of these combs. Plastic combs may break, especially with heavy nit infestation in thick hair, and some parents may complain that it is difficult to move the combs through dense hair. Sturdier metal nit combs are available. The use of ample water, conditioner, diluted vinegar or a commercial nit removal system may help with the combing process.

Combing alone without wetting the hair is often unreliable. Application of diluted vinegar or commercial preparations containing formic acid 8 percent (Step 2, and others) may aid in nit removal by softening the bonding agent and may improve compliance by making combing easier.

**Oral Agents Used Off-Label**

A broad-spectrum anti-parasitic, oral ivermectin (Stromectol) has been used off-label for treatment of head lice when other therapies have failed. Given in an oral dose of 200 µg/kg, ivermectin effectively kills nymphs and lice, but not eggs. To kill newly hatched nymphs, a second dose is given seven to 10 days after the first dose. Treatment with ivermectin occasionally is associated with mild, transient side effects such as rash or pruritus, but no serious adverse reactions have been reported. Resistance has not been reported to ivermectin.

Combination products containing trimethoprim and sulfamethoxazole (Bactrim, Septra, and others) have also been cited in small observational studies and anecdotal reports, as an alternative to topical pediculicides. This antimicrobial action is believed to kill the symbiotic bacteria in the lice gut, which ultimately kills the lice. However, the potential for allergic reactions and risk for promoting bacterial resistance limit its widespread use for this purpose. Like ivermectin, this treatment is not FDA approved.

**Unconventional Treatments**

Some people may consider insecticides unacceptable, due to concern about potential adverse effects such as skin irritation and exacerbation of asthma, or consequences for the environment. They may have experienced previous treatment failure when using insecticides, perhaps due to using an ineffective formulation, using the product incorrectly, or having an infestation of resistant lice. Moreover, aerosols, sold for environmental use, can cause severe bronchoconstriction and should never be used on the head. Patients who do not wish to use topical insecticides to treat head lice infestation may try alternate treatments.

Unconventional remedies include oil-based treatments, gasoline or kerosene, sulfur, garden insecticides, dog lice/flea shampoos and head shaving. Shaving the head is an effective means to remove all insects and their nits; however, routine shaving is no longer advocated since modern pediculicides and/or insect removal by combing are effective when used properly.

Oil-based remedies such as olive oil are thought to immobilize and suffocate the lice. Lice, including their eggs, are difficult to kill by suffocation. Applying olive oil or petrolatum and covering the head with a shower cap for four to six hours a day for three or four consecutive days may succeed. No reliable data support such claims; however, these substances may be difficult to remove by rinsing or shampooing and may be irritating to the eyes and skin. Petrolatum is the preferred treatment for infestation of the eyelashes and eyebrows. It should be rubbed in well.
Auxiliary Measures
Fomite (object that does not convey pathology by itself, but can harbor pathogenic organisms that may be transmitted to people) control is a controversial aspect of lice management. Head lice rarely survive off the host for more than a day or so and intensive efforts to treat the environment are often time-consuming, disruptive and perhaps, unwarranted. At the same time, many experts continue to endorse strategies to minimize fomite transmission. The CDC recommends that all clothing and bedding in contact with the infested person during the two days before pediculicide treatment be laundered in hot water (60°C [140°F]) and placed in the dryer using the hot cycle, or dry cleaned. All nonwashable items should be quarantined in plastic bags for two weeks should any surviving eggs hatch in that time period. Disinfection of combs and brushes in hot water or alcohol is also recommended. Although various home fumigation sprays for use on furniture and environmental insecticide sprays are marketed, little experimental or epidemiologic data on their effectiveness or safety are available to warrant their use.

Patient Information
Pediculicidal products may cause irritation to the eyes and mucous membranes. They should not be used near these areas.

Individuals being treated for lice should be observed closely for the presence of nits for eight to 10 days after initial drug application. Persons with lice or nit infestations that remain after two treatments should be evaluated by a physician to determine the source of infestation or reason for treatment failures. Patients should be advised to not confuse hair spray globules, dandruff or other extraneous debris with nits. The former are easily dislodged and brushed away. Nits remain attached firmly as explained earlier.

Patients may decide to apply a pediculicide product more often than directed because of persistent itching. This subjects them to increased risk of adverse effects, including excessive drying of the skin which, in turn, can incite further itching.

All topical pediculicides should be rinsed from the hair over a sink, rather than in the shower or bath to limit exposure, and with cool water, in order to minimize absorption due to vasodilatation.

By counseling patients on the proper use of pediculidal products, pharmacists can help decrease the likelihood of resistance and unnecessary treatment exposures. Pediculidal therapy should only be initiated when head lice is appropriately diagnosed, and thorough directions regarding treatment should always be provided to all caregivers and family members. Strict compliance with a complete regimen will improve the likelihood of eradicating the insects.

A valuable source of patient information is the National Pediculosis Association. This group is active in lice prevention education and supplies material that can help parents deal with the condition. This association can be accessed at www.headlice.org.

The authors, the Ohio Pharmacists Foundation and the Ohio Pharmacists Association disclaim any liability to you or your patients resulting from reliance solely upon the information contained herein. Bibliography for additional reading and inquiry is available upon request.

This lesson is a knowledge-based CE activity and is targeted to pharmacists in all practice settings.

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1. According to the Food and Nutrition Board, the recom... vectors of human disease.
   a. True  b. False

2. Insects that live on the surface of the host's body are referred to as:
   a. dermoparasites.  c. scleroparasites.
   b. ectoparasites.

3. All of the following statements are true EXCEPT:
   a. each female louse can produce approximately five to six eggs daily.
   b. the lifespan for female lice is 30 to 35 days.
   c. nits appear translucent.
   d. nymphs molt once into sexually mature adults.

4. The louse bite reaction phase that consists of wheals immediately following a bite with subsequent intense itching is:
   a. I.  c. III.
   b. II.  d. IV.

5. Whether or not wet combing is better than dry combing remains controversial.
   a. True  b. False

6. Nits remain attached to hair shafts for as long as:
   a. one month.  c. six months.
   b. three months.  d. 12 months.

7. Pyrethrins are obtained from:
   a. azaleas.  c. feverfew.
   b. chrysanthemums.  d. mistletoe.

   Completely fill in the lettered box corresponding to your answer.

   1. [a] [b]  6. [a] [b] [c] [d]  11. [a] [b] [c] [d]
   2. [a] [b] [c]  7. [a] [b] [c] [d]  12. [a] [b] [c] [d]
   3. [a] [b] [c] [d]  8. [a] [b] [c] [d]  13. [a] [b] [c] [d]
   4. [a] [b] [c] [d]  9. [a] [b]  14. [a] [b] [c] [d]
   5. [a] [b]  10. [a] [b] [c] [d]  15. [a] [b] [c]

   ❑ I am enclosing $10 (member); $15 (nonmember) for this month’s quiz made payable to:
   Ohio Pharmacists Association.

1. Rate this lesson:  (Excellent)  5 4 3 2 1  (Poor)
2. Did it meet each of its objectives?  ❑ yes  ❑ no
   If no, list any unmet
3. Was the content balanced and without commercial bias?
   ❑ yes  ❑ no
4. Did the program meet your educational/practice needs?
   ❑ yes  ❑ no
5. How long did it take you to read this lesson and complete the quiz?

   Comments/future topics welcome.

8. Piperonyl butoxide is included in pyrethrin products because it suppresses which of the following degradation mechanisms of the insect?
   a. Acetylcholinesterase
   b. Glucuronative
   c. Hyaluronidase
   d. Oxidative

9. Permethrin is believed to act by the same mechanism as pyrethrins.
   a. True  b. False

10. Lindane is an:
    a. organobenzene.  c. organophosphate.
    b. organochloride.  d. organosulfide.

11. Malathion is an:
    a. organobenzene.  c. organophosphate.
    b. organochloride.  d. organosulfide.

12. Lice exposed to benzyl alcohol lose the effective use of which of their systems:
    a. circulatory.  c. nervous.
    b. metabolic.  d. respiratory.

13. Spinosad alters the function of:
    a. ascorbic acid.  c. nicotinic acid.
    b. hyaluronic acid.  d. pantothenic acid.

14. Application of dilute vinegar or which of the following may aid in nit removal?
    a. Boric acid  c. Ethyl alcohol
    b. Castor oil  d. Formic acid

15. Stromectol effectively kills:
    a. nymphs and lice, but not eggs.
    b. lice and eggs, but not nymphs.
    c. eggs and nymphs, but not lice.

To receive CE credit, your quiz must be postmarked no later than September 15, 2014. A passing grade of 80% must be attained. CE statements of credit are mailed February, April, June, August, October, and December, until the CPE Monitor Program is fully operational. Send inquiries to opa@ohiopharmacists.org.