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INTERNATIONAL GUIDELINES FOR EFFECTIVE CONTROL OF HEAD LOUSE INFESTATIONS

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Abstract

Head louse infestations are increasing or remain high in most countries. In order to reduce the proportion of children infested with head lice and slow down the emergence of strains of lice resistant to pediculicides, more active involvement of health and educational authorities, as well as parents, is of paramount importance. We suggest that health authorities should introduce more efficient methods for evaluating pediculicides and more stringent regulations for adoption of new anti-louse products. Baseline studies are also essential for new pediculicides. Children should be properly screened, especially in problematic areas. The media should be used to educate parents on louse control. Health providers need to be aware of which anti-louse remedies are demonstrably effective and be capable of assisting families with louse control. Academic institutions should conduct baseline and efficacy studies on pediculicides and other treatment modalities, as well as research on the biology and epidemiology of lice. Parents should regularly inspect their children, treat as necessary, and try to avoid creating stigmas and emotional problems for the child. The pharmaceutical industry should aim to introduce pediculicides based on new chemical compounds, especially natural products. Companies should develop effective and safe repellents and nit removal remedies. General recommendations are given on how to diagnose and treat louse infestations with chemicals, biological agents, and louse combs and how to protect children from infestations. The no-nit policy, based on the persistence of empty egg cases, is not justified and does more harm than good; therefore, we recommend that it be immediately halted.

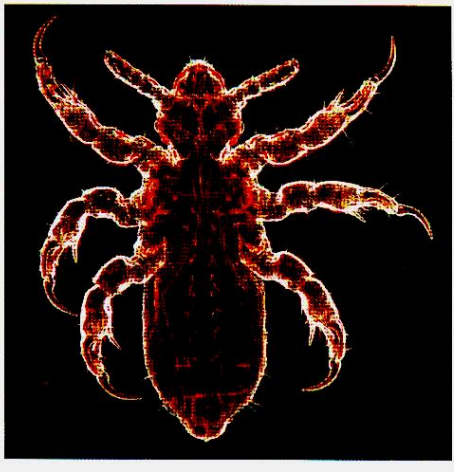
Introduction

The number of cases of human louse infestations has increased worldwide since the mid-1960s,[1] reaching hundreds of millions annually.[2] Each year, about 6 to 12 million people, mainly children, are treated for head lice (*Pediculus humanus capitis*; Figure 1) in the US.[3] High levels of louse infestations were also reported from Israel, Denmark, Sweden, the UK, France, and Australia.[3-7]

During the Second International Congress on Phthiraptera at the University of Queensland in Brisbane, Australia, guidelines for worldwide control of head louse infestations were discussed. Later, a draft was prepared, which was published at the Phthiraptera website (www.phthiraptera.org) and sent to different specialists on human lice worldwide.

The aim of these recommendations is to reduce the percentage of children infested with head lice worldwide and to slow down the emergence of strains of lice resistant to pediculicides. The guidelines are addressed to the different institutions and agencies involved in the control of lice (ie, health authorities, health providers [nurses, pharmacists and

Figure 1. First nymphal stage of the human head louse (*Pediculus humanus capitis*).



physicians], universities, and pharmaceutical industries as well as to parents).

Health Authorities

Regulations for the Introduction of a Pediculicide that has been Clinically Tested in Another Country

Pediculicides that are found to be effective in one region may not be effective in another because of the development of resistant strains of head lice and natural variation among populations in different parts of the globe. Therefore, *in vitro* efficacy studies using local head lice removed from infested individuals or, ideally, clinical studies should be conducted in each country before the pediculicide is introduced into the market. *In vitro* tests using a laboratory colony of body lice, although very helpful in the development of a new pediculicidal formulation, may not be predictive of field results for head lice. All new active ingredients should be tested in assessor-blinded, randomized comparative trials at least once somewhere.

In vitro studies showed that different formulations of the same active ingredient give different results.[8,9] Therefore, each formulation should be tested separately, and it should not be assumed that a given concentration of an insecticide gives the same results in every formulation.

There should be regulations for the premarketing evaluation of a pediculicide (ie, minimum efficacy requirements, side effects, power of clinical trials and details regarding the *in vitro* studies [number of localities and louse specimens to be examined]).

"Natural" remedies should be examined in the same way as "regular" pediculicides and submitted to the same criteria before introduction into the market.

Regulations for Testing of Existing Pediculicides

Pediculicides lose their efficacy due to the development of resistant strains of lice. Therefore, existing pediculicides should be tested periodically *in vitro* or, ideally, in clinical trials to determine whether they are still effective.

Regulations for Medical Agencies

Medical agencies, which may be private or academic institutions, could test the *in vivo* and *in vitro* efficacy of a product, as well as its side effects.

Regulations for the Sale of Pediculicides without Demonstrable Efficacy

Advertising should be clear whether a product is licensed, either as a medicine (pharmaceutical product) or as a medical device. When a product is designed to be used as a combing aid (ie, has no intrinsic activity to kill lice or their eggs) it should be made clear. Terms such as "hair hygiene" or even obscure references to "lice," "nits," or "unpleasant scalp conditions" contravene the spirit if not the letter of the regulations governing advertising of pediculicide products in most countries. Regulatory authorities should be encouraged to enforce their own rules to prevent such misleading terminology and advertising.

Regular Examination of Children with the Help of School Nurses

In kindergarten and schools where there is evidence of an abnormally high number of complaints related to lice infestations, health authorities should arrange for investigation and appropriate advice to the parents.

Baseline Studies

Baseline studies should be initiated for insecticides that are being used in other countries or are candidates for use as pediculicides in the future.

National Committee on Pediculosis

A committee including physicians (pediatricians, dermatologists), epidemiologists, medical entomologists, public health specialists, parents, nurses, social workers, and representatives of the pharmaceutical industry could support evidence-based louse control policies in each country. They could adopt prevention and control strategies, taking into account existing regulations, local customs, and available treatments. The committee could also coordinate the activities of the different institutions that are involved in the control of louse infestations, disseminate information, conduct surveillance, as well as adopt strategies to reduce development of resistance.

Education

There should be continuing education about the biology, prevention, and control of lice for health providers as well as the public via the media and the internet. Public information sheets in different languages and visual aids for families with limited language skills should be available. The advantages and disadvantages of the different treatment methods, recommended pediculicides, and the psychological and emotional aspects related to louse infestation should be covered. It should stress the harm of stigma or punishment.

An authoritative and balanced internet site should be available in each country to give maximum information about louse biology and control, existing treatment methods, pediculicides (instructions for use, efficacy level, side effects, and price), and answers to the most commonly asked questions. The website should also include answers to the public's e-mail queries.

Health Providers

The main aim of health providers should be to equip child care personnel to manage head louse infestations. Health providers such as physicians, nurses, and pharmacists should be updated on new developments related to louse repellents and control. School nurses should address the head louse problem proactively by making information available to parents and investigating institutions with abnormally high incidences. In addition, the school nurse can support families who find it difficult to manage treatment. Pharmacists should only promote pediculicides that they know are effective. They should be able to recommend alternative pediculicides as second-line treatment.

Universities and Other Research Institutions

Academic institutions could conduct baseline susceptibility studies, as well as studies on the efficacy of pediculicides and the development of resistance. In addition, they should inform the public with educational material and cooperate with health authorities. Academic institutions should be involved in basic research on louse biology, physiology, resistance mechanisms, as well as development of new methods for control, screening, repellents, nit removal remedies, combs, and study children/parent interaction during examination and treatment.

Parents

Parents should periodically inspect their children for head louse infestation and treat as necessary. This should be done in such a way as not to create a stigma or shame. Sharing information on infestation with other parents would facilitate case findings. Feedback from parents to health providers in their area about louse infestations and treatment failures would help improve local control. Parents could also volunteer to examine children in their own or other children's schools after receiving the necessary training.

Pharmaceutical Industries

The pharmaceutical industry should aim to introduce pediculicides based on new chemical compounds, especially naturally occurring compounds. They are often complex in nature and as such less prone to resistance. In addition, they are commonly more acceptable to the public, who are sometimes reluctant to use synthetic chemical compounds. A combination of 2 insecticides is an option that could increase the efficacy of pediculicides and decrease the chances of resistance developing. Companies should make verifiable claims on the packaging, such as stressing the limited effect on eggs and therefore the necessity of repeating treatment. It is not sufficient to state that a treatment should be repeated only if the first treatment was not effective. Companies should also give information in the product pamphlets including how to check if the treatment was effective, what to do if not, when and how to use a louse comb, and how to obtain further information. Contraindications and side effects should be listed on the products.

Companies should develop nonflammable lotion or gel formulations. They are more effective than shampoo formulations because they are not highly diluted with water during treatment, except when used without dilution as is recommended for some shampoo formulations in the US. Spray formulations may be inhaled and are therefore less safe. Companies should also explore the development of effective and safe repellents as well as effective nit removal remedies.

General Recommendations

Diagnosis of a Head Louse Infestation

A child is diagnosed with a head louse infestation if a living louse is found on the scalp using a fine-toothed plastic detection comb.[10] Restriction of the term "nit" to the empty eggshell, as distinct from the nonhatched egg, has been encouraged for many years.[11] Nonhatched eggs could be either dead, perhaps from a previous treatment, or alive. It is generally acknowledged that it is very difficult to distinguish viable from nonviable eggs with the naked eye.

The presence of nits alone is not an accurate indicator of an active head louse infestation. Examination of over 15,000 children in Israel using a louse comb revealed that 11% to 19% of the children were infested with living lice and eggs, while another 22% to 30% had nits only.[4] Approximately 80% of these children had nits that were 2 to 5 cm away from the scalp, which was indirect evidence of successfully treated infestations during the previous 2 to 5 months.[12] Accordingly, when the diagnosis of head louse infestation is based on the presence of nits, 1 to 2 out of 3 children are sent home for treatment without justification. Pediculicides will not eliminate nits. Therefore, there would be no change in the appearance of nits on a scalp after an effective pediculicidal treatment. The presence of nits alone is thus interpreted as treatment failure and "infested" individuals continue to be treated unnecessarily. However, children with viable eggs and no lice will remain undetected if only children with live lice are considered positive. But the probability that children with eggs but without lice will develop an infestation is small. In a study conducted in the US, it was found that 1.6% of the school children examined had lice, whereas 3.6% had nits/eggs without lice. The latter were reexamined 14 days after the initial screening and only 21% of these children developed an infestation, which could have been due to eggs that hatched but also could have been due to reinfestation.[13] In any case, if no living lice are detected using an accurate method of detection, the child should be considered negative for head louse infestation. Nobody should be treated with a formulated product unless a thorough investigation reveals living lice in his/her hair. However, children who are infested with nits only should be examined, first on a few consecutive days and then one week later for living lice, since these children are usually at higher risk of a new infection than children that have not been infested in the last 2 to 5 months (ie, children without nits).[13]

Detection Methods for Lice

There are several methods for detecting head lice. Most examinations are done by direct visual examination by hand or with the help of a screening stick and the diagnosis of louse infestation is mainly based on the presence of nits. Combing dry hair with a louse comb is 4 times more effective in the diagnosis of a louse infestation and twice as fast as examination by hand.[10] The distinction between living lice and nits is especially important as living lice indicate active infestation while nits may only indicate past, nonactive infestation.

Direct visual examination therefore commonly underestimates active infestation. It is particularly difficult to diagnose a louse infestation accurately by hand examination, then approximately 78% of the infested children have 1 to 10 lice on their scalp, 18.7% have 11 to 20 lice, and only 3.3% have over 20 lice.[12] Most of the lice on the scalp are nymphs,[14] 1 to 2 mm in length and therefore difficult to see without a magnifying glass. In addition, direct visual examination reveals a higher percentage of children with nits only than the examination with a comb, as the examining person spends

more time looking at the hair rather than at the comb. Therefore, the chances of diagnosing a false-positive infestation are greater when examining by hand.

In those children with long and/or curly and frizzy hair where the use of a comb on dry hair is very difficult, the inspection could be done by direct visual examination by hand or with the help of a screening stick as well as by treating the hair with conditioner or oil and using a louse comb. As the detection of lice in long and curly/frizzy hair is more difficult, the examination should last longer.

Measures to be Taken after the Diagnosis at School

Children with lice or nits should be sent home at the end of the day with a letter to their parents suggesting that the child be examined and if necessary treated the same day. However, excluding children from school because of the presence of lice or nits is not recommended. Parents should be given a pamphlet offering an informed choice of treatment methods and notification of whom to ask if there are questions about which pediculicides or other treatment methods would give the best results. Parents could be requested to fill in a questionnaire about when the first treatment session was carried out, when consecutive sessions will be done, if necessary, and which product was used. Children should be allowed to return to school immediately after the first treatment session. Ideally, the school nurse could check for lice on the 10th day after the letter was sent and do follow-up inspections until the treatment is successful (ie, re-treat on day 10 not day 7).

Treatment

Treatment with Pediculicides

Only anti-louse products that have been specifically approved should be used. It is necessary to carefully read and follow the instructions for use. It is particularly important to note the starting time and to treat the hair for the exact period specified in the instructions.

In cases where a member of the family is found to be infested, all other family members should be examined, but only those infested should be treated. These treatments should take place simultaneously and on the same day if possible.

Ten days after a single treatment or a day after the last treatment (for those products that should be used more than once) the scalp should be reexamined using a louse comb. If no living lice are found, the treatment was successful even if nits are still visible on the scalp. If living lice are still present the treatment should be continued, but a pediculicide with a different active ingredient should be used.[8] Lice can live for only 1 to 2 days away from the host.

Treatment with a Louse Comb

Systematic use of a louse comb over the 10-day period in which the eggs hatch can remedy an infestation. Successful treatment by combing alone (also known as wet combing or bug busting) is possible if the hair is combed daily or every second day for a period of 12 to 14 days. However, this technique is indicated especially for children with short or medium length, straight or wavy hair. Three clinical studies in the UK showed that combs are capable of removing the entire population of lice from the hair in 38% to 53% of children.[6,15,16] Combing should always be an integral part of any pediculicidal treatment in order to remove live and dead lice, eggs, and nits. In addition, a louse comb should be used for the diagnosis of a louse infestation, for verification that treatment with a pediculicide was successful, and for the removal of eggs and nits. Wet combing is possibly a valid alternative to pediculicides for motivated parents. However, more efficacy trials are needed.[17]

Nits and Nit Removal Remedies

One of the problems with head louse control is that of nits. The female louse often lays her eggs at the base of the hair close to the scalp, attaching them to the hair with quick-hardening glue excreted from her body. The young lice hatch 6 to 10 days later leaving the eggshell behind. Dead eggs and eggshells (nits) may remain attached to the hair for 12 months. Human hair grows at a rate of about 1 cm per month and the nits move away from the scalp as the hair grows. After 2 to 3 months, the nits are more visible, particularly on dark hair. The appearance of eggs several months after the last treatment can lead to a false positive diagnosis of infestation as most people assume that if eggs are present the child must also have lice. In general, louse eggs found more than 1 cm from the scalp are unlikely to be viable, but some researchers in warmer climates have found viable eggs further away from the scalp.[18]

The removal of dead eggs and empty eggshells is not essential for therapeutic reasons but is sometimes done for aesthetic reasons. In school, the shunning of a child with a noticeable burden is by no means trivial, and the removal of dead eggs and empty shells is required to avoid stigmatization of the child.

Mechanically removing eggs and eggshells is time-consuming. Removal of nits with a louse comb is easier when the hair is wet or after shampooing or treatment with a conditioner. However, this method is not suitable for removing freshly laid eggs and should be repeated weekly for several weeks. There are no nit removal remedies on the market that have been tested *in vitro* or under clinical conditions.

Treatments not Recommended

Insecticides and other chemicals not specifically labeled for use on humans or for the treatment of head lice should not be used. Gasoline or kerosene, alone or in combination with vinegar and oil, is especially toxic and flammable and therefore should never be used. Prophylactic treatment with pediculicides is not recommended due to possible adverse effects including rapid selection for pediculicide resistance. There is no reason to treat inanimate objects like clothes, furniture, carpets, or the interior of the car. No insecticides should be used to treat the house. The use of antibiotics such as trimethoprim and sulfamethoxazole for prevention or control is not recommended as there is little scientific evidence of their efficacy. Shaving the head or even an unusually short haircut for prevention or control of lice is not recommended due to the psychological damage the child might experience.

Prophylaxis

Regular Examinations

Examination of the child's head at regular intervals using a louse comb allows the diagnosis of louse infestation at an early stage. Early diagnosis makes treatment easier and reduces the possibility of infesting others. In times and areas when louse infestations are common weekly examinations by parents of children, especially those 4 to 13 years old, will aid in control.

Repellents

Essential oils such as rosemary, citronella, and piperonal have been tested for repellency to laboratory colonies of body lice.[19] One placebo-controlled clinical trial demonstrated the efficacy of a citronella formulation as a louse repellent.[20]

Other Preventive Measures

Head-to-head contact is by far the major route of transmission for head lice. Studies in Australian schools showed that classroom floors, brushes, and hats are not risk factors for pediculosis. The chances of a live head louse or egg becoming reunited with a person would seem exceptionally remote.[21] Nevertheless, not sharing brushes or combs with other family members or friends, keeping girls' hair tidy, being well informed on the biology and control of lice, and regular examinations are helpful in the prevention of infestations with head lice.

The "No-Nit" Policy

The "no-nit" policy, which is implemented in approximately 80% of schools in the US and in parts of Canada and Australia, requires the dismissal of a child from a school, camp, or child care setting until all head lice, eggs, and nits have been removed from the hair of an infested individual. Because in most of the screenings the diagnosis of a head louse infestation is based on the presence of nits on the hair, it is assumed that all eggs/nits found on the scalp are viable and therefore should be removed.

The no-nit policy is commonly adopted because it is assumed that health professionals cannot differentiate between live and dead eggs or because the screeners refuse to use a louse comb for the examination of the child's head to find living lice. Therefore, parents are forced to remove every single nit from the scalp of their children. This involves long hours of picking nits, repeated treatments with pediculicides, and absence from school for the child and possibly from work for at least one parent. There are also negative effects on the parent-child relationship, especially when combing becomes painful and the parent and/or child become impatient. Moreover, even if the visible nits are removed from the scalp, it does not necessarily mean that the person is no longer infested with lice. The immediate expulsion of children from a camp, kindergarten, or school may cause significant damage to their self esteem and also upsets their parents.

The efficacy of the no-nit policy was questioned by different groups of scientists[4,13,16,22-26] and by several agencies, including the American Academy of Pediatrics and the National Association of School Nurses (US). In Australia, the National Health and Medical Research Council's Guidelines for Infectious Diseases warranting school exclusion have been recently amended to exclude head lice.[23] Furthermore, there are no convincing data that show enforced exclusion policies are effective in reducing the transmission of lice. Therefore, the no-nit policy is unjust as it is based on misinformation rather than objective science and should be discontinued.[25,26]

References

1. Gratz N. *Human lice, their prevalence and resistance to insecticides.* Geneva: WHO, 1998.
2. Taplin D, Meinking TL. Pyrethrins and pyrethroids for the treatment of scabies and pediculosis. *Semin Dermatol.* 1987;6:125-135.
3. Atkinson L, Clore ER, Kisel BEEA. Internal and external parasites. *Pediatrics.* 1986;1:1-7.
4. Mumcuoglu KY. Prevention and treatment of head lice in children. *Pædiatr Drugs.* 1999;1: 211-218.
5. Rasmussen AM, Larsen KS. A questionnaire on head lice (*Pediculus capitis*). Report 12-1999 (in Danish). *Danish Pest Infest Lab.* 1999:37.
6. Roberts RJ, Casey D, Morgan DA, Petrovic M. Comparison of wet combing with malathion for treatment of head lice in the UK: a pragmatic randomised controlled trial. *Lancet.* 2000;356:540-544.
7. Cheneveau JP, Combescot-LangC, Cassegrain M-C, Marco S. Historical epidemiology study of pediculicides at Tours (France) from 1990-2004. Use of DFMT to identify pediculosis chronic cases. Comparative study on pediculicide effectiveness. *J Parasitol.* (In Press).
8. Mumcuoglu KY, Miller J. The efficacy of pediculicides in Israel. *Isr J Med Sci.* 1991;27:562-565.
9. Burgess I. Human lice and their management. *Adv Parasit.* 1995; 36:271-342.
10. Mumcuoglu KY, Friger M, Ioffe Uspensky I, Ben Ishai F, Miller J. Louse comb versus direct visual examination for the diagnosis of head louse infestations. *Pediatr Dermatol.* 2001;18:9-12.
11. Maunder JW. The appreciation of lice. *Proc R Inst Great Britain.* 1983;55:1-31.
12. Mumcuoglu KY, Miller J, Gofin R, Adler B, et al. Epidemiological studies on head lice infestation in Israel. I. Parasitological examination of children. *Int J Dermatol.* 1990;29:502-506.
13. Williams LK, Reichert A, MacKenzie WR, Hightower AW, Blake PA. Lice, nits, and school policy. *Pediatrics.* 2001;107:1011-1015.
14. Buxton PA. *The louse: an account on the lice which infest man, their medical importance and control.* London: Arnold, 1950.
15. Mumcuoglu KY. Effective treatment of head louse with pediculicides. *J Drug Dermatol.* 2006;5:451-452.
16. Bingham P, Kirk S, Hill N, Figueroa J. The methodology and operation of a pilot randomized control trial of the effectiveness of the Bug Busting method against a single application insecticide product for head louse treatment. *Public Health.* 2000;114:265-268.
17. Plastow L, Luthra M, Powell R, Wright J, et al. Lice infestation: bug busting vs. traditional treatment. *J Clin Nurs.* 2001;10:775-783.
18. Vander Stichele RH, Dezeure EM, Bogaert MG. Systematic review of clinical efficacy of topical treatments for head lice. *BMJ.* 1995; 311:604-608.
19. Meinking TL. Infestations. Curr Probl Dermatol. 1999;11:73-120.

20. Mumcuoglu KY, Galun R, Bach U, Miller J, Magdassi S. Repellency of essential oils and their components to the human body louse, *Pediculus humanus humanus*. *Entomol Exp Appl.* 1996;78: 309-314.

21. Mumcuoglu KY, Magdassi S, Miller J, Ben-Ishai F, et al. The in vivo repellency of a citronella formulation for the human head louse, *Pediculus humanus capitis*. *Isr Med Assoc J.* 2004;6:756-759.

22. Price JH, Burkhart CN, Burkhart CG, Islam R. School nurses' perceptions of and experiences with head lice. *J Sch Health.* 1999;69: 153-158.

23. Pollack RJ, Kiszewski AE, Spielman A. Overdiagnosis and consequent mismanagement of head louse infestations in North America. *Pediatr Infect Dis J.* 2000;19:689-693.

24. Dolianitis C, Sinclair R. Optimal treatment of head lice: is a no-nit policy justified? *Clin Dermatol.* 2002;20:94-96.

25. Roberts RJ. Head lice (review). *N Eng J Med.* 2002; 346: 1645-1650.

26. Mumcuoglu KY, Meinking T, Burkhart CN, Burkhart CG. Head louse infestation: the "no-nit" policy and its consequences. *Int J Dermatol.* 2006;45:i–xvii.

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