Using Insect and Tick Repellents Safely

Repellents are chemicals applied to provide relief and protection from mosquitoes, ticks, and other biting pests. Proper and safe use of these chemicals is necessary.

Diseases Transmitted by Arthropods

During the summer months, arthropods, including mosquitoes and ticks, are as common as backyard picnics and swimming pools. Unfortunately, they bring with them not only the discomfort of bites, but also the possibility of transmitting human and animal diseases. Two diseases of concern that occur in the United States are West Nile encephalitis, transmitted by mosquitoes, and Lyme disease, transmitted by ticks.

West Nile encephalitis was first documented in the Western Hemisphere in August 1999 when an outbreak occurred in the New York City metropolitan area. In 1999, the Centers for Disease Control and Prevention (CDC) confirmed sixty-two human cases of West Nile encephalitis, including seven deaths, although the actual human infection rate was much higher. Infected mosquitoes transmit the West Nile virus. These mosquitoes usually bite and infect wild birds—the primary hosts of the virus—but can also infect horses and other mammals in addition to humans. The West Nile virus has been detected throughout the entire United States. In Pennsylvania, the West Nile virus has been detected every year since 2000.

Lyme disease was identified in the United States in 1975 after a mysterious outbreak of arthritis in Lyme, Connecticut. Since then, reports of Lyme disease have increased dramatically, and the disease has become an important public health problem in some areas of the United States. Lyme disease is an infection caused by a member of the corkscrew-shaped bacteria known as spirochetes. In the Northeast, the deer tick (I. scapularis) is most commonly associated with transmitting this disease to humans.

In addition to West Nile encephalitis, mosquitoes can also transmit dog heartworm; the eastern equine, western equine, and St. Louis equine encephalitis viruses; and Zika virus. Besides Lyme disease, ticks can transmit Rocky Mountain spotted fever, Colorado tick fever, relapsing fever, tick paralysis, tularemia, babesiosis, and ehrlichiosis. Some of these diseases are present only sporadically, but when they do occur outbreaks can be severe.

Avoiding Contact with Mosquitoes and Ticks

Mosquitoes and ticks prefer certain types of environments. By avoiding these areas or eliminating these environments from your outdoor living areas, you can reduce your chance of being bitten.

Reducing the number of mosquitoes around your home and neighborhood can be done by eliminating standing water, in which mosquitoes breed. Dispose of anything outside that can hold water, such as tin cans, ceramic pots, and used tires. Drill holes in the bottoms of recycling containers left outdoors. Clean clogged roof gutters every year. Turn over plastic swimming/wading pools and wheelbarrows when not in use. Do not allow water to stagnate in birdbaths, ornamental pools, water gardens, and swimming pools or their covers. Do not forget about natural breeding sites, such as tree holes, rock pools, or and fish-less ponds. Alter the landscape of your property to eliminate standing water. Keep in mind that mosquitoes can breed in any puddle of water during warm weather and that they can complete their development in under a week.
Ticks thrive in a different type of environment—mainly wooded, brushy, and grassy places—and prefer shaded areas because they are prone to dehydration. Campers, hikers, outdoor workers, and others who frequent these areas are more likely to come into contact with ticks. For homeowners, exposure to ticks is greatest in the woods and garden-fringe areas of their properties, but ticks can also be carried by animals into lawns and gardens.

You can determine if you have a high tick population by sweeping or dragging your yard's vegetation with a white cloth attached to a dowel, then inspecting the cloth for ticks. Removing firewood and clearing leaves, brush, and tall grass from around houses and at the edges of gardens can reduce the number of ticks by reducing the number of rodents present.

Although we can avoid or try to eliminate environments where insects and ticks live, we cannot totally eliminate our exposure to these pests. However, we can use insect repellents to make ourselves less attractive to insects and ticks.

**General Pest Prevention Tips**

- Make sure window and door screens are "bug tight."
- Wear long-sleeved shirts and long pants if you must go outdoors.
- If you must, work with a Pest Management Professional (PMP) for site-specific actions you can take to reduce arthropod biting pressure and to determine if the following treatments are appropriate: Mosquito treatments such as fogging, barrier treatments, traps, and/or baiting Tick barrier treatments Rodent treatments for ticks
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The PMP should have a valid state-issued pesticide applicator certification and may have additional credentials from the National Pest Management Association, American Mosquito Control Association, or the CDC.

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**Mosquito Prevention Tips**

- Use the proper type of lighting outside—incandescent lights attract mosquitoes, while fluorescent lights neither attract nor repel them.
- Mosquitoes are repelled by high winds, so electric fans may provide some relief at outdoor events.
- Stay indoors at dawn, dusk, and in the early evening, when mosquitoes are most active.
- Vitamin B and "ultrasonic" devices have not been proved effective in preventing mosquito bites.

**Tick Prevention Tips**

- Avoid deer tick-infested areas, especially in May, June, and July. However, adult ticks can become active anytime the temperature goes above 28°F and when there is no snow on the ground.
- Wear light-colored clothing so that ticks can be spotted more easily.
- Tuck pant legs into socks or boots; tuck shirt into pants.
- After being outdoors, remove clothing and wash and dry it at a high temperature.
- Inspect your body carefully. Remove attached ticks with tweezers, grasping the tick as close to the skin surface as possible and pulling straight back with a slow and steady force; avoid crushing the tick's body.

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**What are Repellents?**

Repellents are chemicals applied to exposed skin or clothing that can provide some relief and protection from mosquitoes, ticks, and other biting pests. Repellents containing the active ingredient N,N-diethyl-mtoluamide or N,N-diethyl-3-methylbenzamide—both better known as DEET—are effective in repelling mosquitoes, biting flies, chiggers, fleas, and ticks. DEET has been available to the general public since 1957. According to the Environmental Protection Agency (EPA), DEET is used annually by about one-third of Americans. DEET is used safely by millions of people worldwide.

**To use a Repellent safely, you must use it properly.**

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**Guidelines for Safe Application**

Follow these guidelines when using insect repellents, especially when applying them to children.

- Verify that the product has an EPA registration number; its presence means the product label was approved by the EPA.
- Before using any product, read and understand the directions on its label.
• Do not spray a repellent in an enclosed area or near food, and do not inhale aerosol formulations.

• According to the AAP, insect repellents should not be used on infants under two months of age. Other guidelines recommend not using insect repellents until children are two years of age.

• Use just enough repellent to lightly cover exposed skin and clothing. Never apply repellents to cuts, wounds, or inflamed and irritated skin. Do not saturate the skin or apply beneath clothing.

• To apply a repellent to your face, first dispense or spray it onto your palms and rub your hands together. Then apply a thin layer to the surface of your skin. Do not place repellent in your eyes or mouth.

• Do not allow children to apply insect repellents by themselves. Do not apply a repellent directly to a child’s skin. First apply it to the palms of your own hands and then apply it to the child. Do not apply repellent to children’s hands because they may touch their eyes and mouth, causing irritation.

• DEET can damage plastics, synthetic fabrics, leather, and painted or varnished materials. DEET does not damage natural fibers, such as cotton or wool.

• After applying a repellent, wipe or wash it from your hands.

• A single application of a repellent is sufficient under most conditions. Avoid prolonged or excessive use of insect repellents.

• If a sunscreen product is needed, it should be applied first, followed by an insect repellent product. The CDC does not recommend using a combination sunscreen/insect repellent product. Sunscreen effectiveness may require more additional applications than the repellent, hence the recommendation for using two separate products.

• Once indoors, wash all treated skin and clothing with soap and water. Wash treated clothing before wearing it again.

• If you suspect that you or your child is reacting negatively to an insect repellent, discontinue its use, wash treated skin, and call the National Poison Center at 1-800-222-1222. If you must see a doctor, take the repellent with you, as the label will provide the doctor with additional medical information.

A very small segment of the population may be sensitive to one or more insect repellents. For more information about insect repellents, contact the National Pesticide Information Center at 1-800-858-7378 (limited hours) or visit their Web site or contact your health care provider.

Choosing an Appropriate Concentration of Repellent

A variety of products containing insect repellents (e.g., lotions, creams, gels, aerosols, pump sprays, and towelettes) can be purchased in concentrations ranging from 4 to 100 percent. For most adults who prefer a DEET-based repellent, products containing 10 to 35 percent DEET will provide adequate protection under most conditions.

The American Academy of Pediatrics (AAP) has updated their DEET recommendations for children, citing: “Insect repellents containing DEET with a concentration of 10 percent appear to be as safe as products with a concentration of 30 percent when used according to the directions on the product labels.”

Repellent products containing a higher concentration of active ingredients do not necessarily indicate better protection, only that the protection will last longer as is the case with DEET. These products are more suitable when mosquitoes and other pests are present in large numbers and when conditions lead to rapid loss of repellent from the skin, such as when the temperature and humidity are high, causing significant perspiration. For example, DEET efficacy peaks at around 50 percent. Products that contain concentrations exceeding 50 percent DEET do not provide significant improvement in protection.

People differ in how attractive they are to mosquitoes, so the efficacy of a repellent varies among people. Efficacy of a repellent also varies among species of ticks and biting flies. Repellents usually remain effective for one to five hours. The length of time depends on several factors, including the degree to which a person has perspired, the extent to which a person has rubbed his or her skin, and the amount of repellent that has been applied. Nevertheless, it is wise to use a product with the lowest concentration of active ingredient that you have found to be personally effective. To use a repellent safely, you must use it properly. Read the product’s label and follow all directions.

Is DEET Safe?

Having been in use for sixty years, DEET has been well studied and has a remarkable safety record. Nevertheless, concerns have been raised about using DEET as a repellent. Laboratory testing has shown that DEET is absorbed through the skin, but once in the body, it is readily eliminated in the urine, with the highest urinary concentrations occurring several hours after application. However, studies on both animals and people indicate that DEET does not accumulate in the body. Cases of illness caused by DEET have been reported in the medical literature, but in most of these cases, DEET was used inappropriately, excessively, or repeatedly over a long period.
Alternatives to DEET

Although DEET remains the “gold standard” for repellents, a number of other highly effective repellent active ingredients are available. Guidance from the CDC includes four additional active ingredients that have been shown to offer long-lasting protection against mosquito bites.

- **Picaridin** (or KBR 3023) has been used safely and effectively in other parts of the world for some time. Evidence shows that picaridin is often comparable with DEET products of similar concentration.
- **Oil of lemon eucalyptus** (OLE, or p-menthane 3,8-diol [PMD], a synthetic version) is a plant-based mosquito repellent that provides protection similar to low concentrations of DEET. The label for this product specifies that it should not be used on children under three years of age.
- **IR3535** (ethyl butylacetylaminopropionate) is a synthetically produced amino acid with demonstrated effectiveness as a repellent.
- **2-undecanone** is a synthetic version of a naturally occurring chemical that is found in various plants.

Many **plant-derived repellents** have not been demonstrated to have the broad and substantial efficacy of currently recommended repellents, although thousands of plants have been tested as potential sources of insect repellents. A few plants whose essential oils have shown repellent activity against insects include allspice, basil, cajeput, cedar, cinnamon, citronella, eucalyptus, garlic, geranium, lavender, lemongrass, pennyroyal, peppermint, pine, rosemary, soybean, thyme, and verbena. Most of these oils give short-lasting protection, generally less than two hours.

Permethrin

**Permethrin**, a synthetic pyrethroid, is the most effective deterrent for ticks. Permethrin is applied to clothing, not skin. Permethrin is a powerful, rapidly acting insecticide that kills ticks and insects that come in contact with treated clothes. Pretreated clothing is also commercially available from several manufacturers. Note that pretreated clothing is a pesticide product, registered with the EPA, and has a product label. The effectiveness of both treated and pretreated clothing can last several weeks or longer with proper laundering. Read the product label to use permethrin products safely and effectively. Follow these guidelines when using permethrin repellents:

- Again, read the entire product label.
- **Treat clothing only; do not apply to skin.**
- Apply to clothing outdoors in a well-ventilated area that is protected from the wind.
- Only treat the outer surface of clothing with permethrin repellents, and do not apply to clothing while it is being worn.
- Only spray enough to lightly moisten the outer surface of the fabric, causing a slight color change or darkening; do not saturate clothing.
- Hang treated clothing outdoors and allow it to dry completely before wearing.
- Launder treated clothing separately from other clothing.
- Keep treated clothes in a separate bag when not in use.
- Treat exposed parts of the body (not covered with treated or pretreated clothing) with insect repellents labeled for skin for more complete protection.

How to Read an Insect Repellent Label

Because so many different insect repellent products are available, you might find it difficult to choose the right one for your needs. However, the product’s label will provide important information about active ingredients, proper handling and application, and first aid. You should always read and understand the label before using any pesticide product. A few sections of the label are described and a fictitious label is illustrated below.

The first thing to look for on a product label is an EPA registration number (as indicated by the letter “A”). This number indicates that the label has been approved by the Environmental Protection Agency. The product label will list the active ingredients and their concentration (indicated by the letter “B”). For DEET products, the word “DEET” may not be listed; instead, its chemical name, “N,N-diethyl-m-toluamide,” may be listed as the active ingredient. Again, the concentration will help you choose appropriate products for the length of protection that you need.

Proper application and directions for use are also listed on the label (indicated by the letter “C”). For insect repellents, you should look to see if the product is to be applied on your skin or just on your clothing, how the product should be applied to children, and if it can be used indoors. Every label will have treatment instructions listed within the precautionary statement or in a section called first aid. This section (indicated by the letter “D”) contains any possible hazards of using the product and what you should do if the product would get into your eyes or be swallowed. Emergency telephone numbers may also be listed.

The product label provides other important information, such as what pests are repelled and manufacturer contact information. Be sure to read the entire product label since not all labels are organized in the same way.
New Tools for Selecting a Repellent

Repellent effectiveness against mosquitoes and ticks varies. The EPA recently introduced a new graphic to explain repellent activity against ticks and mosquitoes for individual products. The graphic does not replace the standard requirements included on a repellent label. Manufacturer use of the graphic is voluntary; therefore, consumers may not see it on products currently on the shelf.

On the left, below the sample label, are examples of what may be displayed on the repellent container. The graphics clearly show what the product protects against and typically how many hours the product will work effectively.

Another tool from the EPA is a searchable database available at www.epa.gov/insect-repellents/find-repellent-right-you to help you choose the tick and/or mosquito repellent that matches your needs, such as what pest you need protection against and for how long. You can also search by active ingredient, specific product, or EPA registration number. This database only includes repellents that are applied to your skin. Keep in mind that not all products listed may be available in your area.

References

Centers for Disease Control and Prevention. "Protection against Mosquitoes, Ticks, and Other Arthropods." Yellow Book 2018.