

Protection against Mosquitoes, Ticks, & Other Insects & Arthropods

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Vaccines or chemoprophylactic drugs are available to protect against some vectorborne diseases such as yellow fever and malaria; however, travelers still should be advised to use repellents and other general protective measures against biting arthropods. The effectiveness of malaria chemoprophylaxis is variable, depending on patterns of drug resistance, bioavailability, and compliance with medication, and no similar preventive measures exist for other mosquito-borne diseases such as dengue or chikungunya. There has been a recent resurgence in bed bug infestations worldwide, particularly in developed countries ([Box 2-03](#)).

CDC recommends the use of products containing active ingredients that have been registered by the Environmental Protection Agency (EPA) for use as repellents applied to skin and clothing. EPA registration of active ingredients indicates the materials have been reviewed and approved for efficacy and human safety when applied according to the instructions on the label.

GENERAL PROTECTIVE MEASURES

Avoid outbreaks. To the extent possible, travelers should avoid known foci of epidemic disease transmission. The CDC website provides information on regional disease transmission patterns and outbreaks (www.cdc.gov/travel).

Be aware of peak exposure times and places. Exposure to arthropod bites may be reduced if travelers modify their patterns of activity or behavior. Although mosquitoes may bite at any time of day, peak biting activity for vectors of some diseases (such as dengue and chikungunya) is during daylight hours. Vectors of other diseases (such as malaria) are most active in twilight periods (dawn and dusk) or in the evening after dark. Avoiding the outdoors or focusing preventive actions during peak hours may reduce risk. Place also matters; ticks are often found in grasses and other vegetated areas. Local health officials or guides may be able to point out areas with increased arthropod activity.

Wear appropriate clothing. Travelers can minimize areas of exposed skin by wearing long-sleeved shirts, long pants, boots, and hats. Tucking in shirts, tucking pants into socks, and wearing closed shoes instead of sandals may reduce risk. Repellents or insecticides, such as permethrin, can be applied to clothing and gear for added protection.

Check for ticks. Travelers should inspect themselves and their clothing for ticks during outdoor activity and at the end of the day. Prompt removal of attached ticks can prevent some infections.

Bed nets. When accommodations are not adequately screened or air conditioned, bed nets are essential to provide protection and to reduce discomfort caused by biting insects. If bed nets do

not reach the floor, they should be tucked under mattresses. Bed nets are most effective when they are treated with a pyrethroid. Pretreated, long-lasting bed nets can be purchased before traveling, or nets can be treated after purchase. Nets treated with a pyrethroid insecticide will be effective for several months if they are not washed. Long-lasting pretreated nets may be effective for much longer.

Insecticides and spatial repellents. An increasing array of products to be used as spatial repellents (containing active ingredients such as metofluthrin and allethrin) is becoming commercially available. These augment the aerosol insecticides, vaporizing mats, and mosquito coils that have been available for some time. Such products can help to clear rooms or areas of mosquitoes (spray aerosols) or repel mosquitoes from a circumscribed area (coils, spatial repellents). Although many of these products appear to have repellent or insecticidal activity under particular conditions, they have not yet been adequately evaluated in peer-reviewed studies for their efficacy in preventing vectorborne disease. As such, travelers should supplement the use of these products with topical or clothing repellents or bed nets in areas with the potential for vectorborne disease transmission or if biting arthropods are noted. Since some products available internationally may contain pesticides that are not registered in the United States, it may be preferable for travelers to bring their own. Insecticides and repellent products should always be used with caution, avoiding direct inhalation of spray or smoke.

Optimum protection can be provided by applying the repellents described in the following sections to clothing and to exposed skin.

Box 2-03. Bed bugs and international travel

A recent resurgence in bed bug infestations worldwide, particularly in developed countries, is thought to be related to the increase in international travel, pest control strategy changes in travel lodgings, and insecticide resistance. Bed bug infestations have been increasingly reported in hotels, theaters, and any locations where people congregate, even in the workplace, dormitories, and schools. Bed bugs may be transported in luggage and on clothing. Transport of personal belongings in contaminated transport vehicles is another means of spread of these insects.

Bed bugs are small, flat insects that are reddish-brown in color, wingless, and range from 1 to 7 mm in length. While bed bugs have not been shown to transmit disease, their bites can produce strong allergic reactions and considerable emotional stress.

Protective Measures against Bed Bugs

Travelers should be encouraged to take the following precautions to avoid or reduce their exposure to bed bugs:

- Inspect the premises of hotels or other unfamiliar sleeping locations for bed bugs on mattresses, box springs, bedding, and furniture, particularly built-in furniture with the bed, desk, and closets as a continuous structural unit. Travelers who observe evidence of

bed bug activity—whether it be the bugs themselves or physical signs such as blood-spotting on linens—should seek alternative lodging.

- Keep suitcases closed when they are not in use and try to keep them off the floor.
- It is best in high-risk areas to remove clothing and personal items, such as toiletry bags and shaving kits, from the suitcase only when they are in use.
- Carefully inspect clothing and personal items before returning them to the suitcase.
- Keep in mind that bed bug eggs and nymphs can be very small and are easily overlooked.

Prevention is by far the most effective and inexpensive way to protect oneself from these pests. The costs of ridding a personal residence of these insects are considerable, and efforts at control are often not immediately successful even when conducted by professionals.

REPELLENTS FOR USE ON SKIN AND CLOTHING

CDC has evaluated information published in peer-reviewed scientific literature and data available from EPA to identify several EPA-registered products that provide repellent activity sufficient to help people reduce the bites of disease-carrying mosquitoes. Products containing the following active ingredients typically provide reasonably long-lasting protection:

- **DEET** (chemical name: N,N-diethyl-m-toluamide or N,N-diethyl-3-methyl-benzamide). Products containing DEET include, but are not limited to, Off!, Cutter, Sawyer, and Ultrathon.
- **Picaridin** (KBR 3023 [Bayrepel] and icaridin outside the United States; chemical name: 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester). Products containing picaridin include, but are not limited to, Cutter Advanced, Skin So Soft Bug Guard Plus, and Autan (outside the United States).
- **Oil of lemon eucalyptus (OLE)** or **PMD** (chemical name: para-menthane-3,8-diol), the synthesized version of OLE. Products containing OLE and PMD include, but are not limited to, Repel. This recommendation refers to EPA-registered repellent products containing the active ingredient OLE (or PMD). “Pure” oil of lemon eucalyptus (essential oil) is not the same product; it has not undergone similar, validated testing for safety and efficacy, is not registered with EPA as an insect repellent, and is not covered by this recommendation.
- **IR3535** (chemical name: 3-[N-butyl-N-acetyl]-aminopropionic acid, ethyl ester). Products containing IR3535 include, but are not limited to, Skin So Soft Bug Guard Plus Expedition.

EPA characterizes the active ingredients DEET and picaridin as “conventional repellents” and OLE, PMD, and IR3535 as “biopesticide repellents,” which are derived from natural materials.

Repellent Efficacy

Published data indicate that repellent efficacy and duration of protection vary considerably among products and among mosquito species. Product efficacy and duration of protection are also markedly affected by ambient temperature, level of activity, amount of perspiration, exposure to water, abrasive removal, and other factors. In general, higher concentrations of active ingredient provide longer duration of protection, regardless of the active ingredient. Products with <10% active ingredient may offer only limited protection, often 1–2 hours. Products that offer sustained-release or controlled-release (microencapsulated) formulations, even with lower active ingredient concentrations, may provide longer protection times. Studies suggest that concentrations of DEET above approximately 50% do not offer a marked increase in protection time against mosquitoes; DEET efficacy tends to plateau at a concentration of approximately 50%.

Recommendations are based on the summary of peer-reviewed journal articles and scientific studies and data submitted to regulatory agencies. People may experience some variation in protection from different products. Regardless of what product is used, if travelers start to get insect bites they should reapply the repellent according to the label instructions, try a different product, or, if possible, leave the area with biting insects.

Repellents should be purchased before traveling and can be found online or in hardware stores, drug stores, and supermarkets. A wider variety of repellents can be found in camping, sporting goods, and military surplus stores. When purchasing repellents overseas, look for the EPA-registered active ingredients on the product labels; some names of products available internationally have been specified in the list above.

Repellents and Sunscreen

Repellents that are applied according to label instructions may be used with sunscreen with no reduction in repellent activity; however, limited data show a one-third decrease in the sun protection factor (SPF) of sunscreens when DEET-containing insect repellents are used after a sunscreen is applied. Products that combine sunscreen and repellent are not recommended, because sunscreen may need to be reapplied more often and in larger amounts than needed for the repellent component to provide protection from biting insects. In general, the recommendation is to use separate products, applying sunscreen first and then applying the repellent.

Repellents and Insecticides for Use on Clothing

Clothing, hats, shoes, bed nets, mesh jackets, and camping gear can be treated with permethrin for added protection. Products such as Permanone and Sawyer permethrin are registered with EPA specifically for this use.

Permethrin is a highly effective insecticide-acaricide and repellent. Permethrin-treated clothing repels and kills ticks, mosquitoes, and other biting and nuisance arthropods. Clothing and other items must be treated 24–48 hours in advance of travel to allow them to dry. As with all pesticides, follow the label instructions when using permethrin clothing treatments.

Alternatively, clothing pretreated with permethrin is commercially available, marketed to consumers in the US as Insect Shield.

Permethrin-treated materials retain repellency or insecticidal activity after repeated laundering but should be retreated, as described on the product label, to provide continued protection. Clothing treated with the other repellent products described above (such as DEET) provides protection from biting arthropods but will not last through washing and will require more frequent reapplications.

Precautions when Using Insect Repellents

Travelers should take the following precautions:

- Apply repellents only to exposed skin or clothing, as directed on the product label.
- Do not use repellents under clothing.
- Never use repellents over cuts, wounds, or irritated skin.
- Do not apply repellents to eyes or mouth, and apply sparingly around ears.
- When using sprays, do not spray directly on face—spray on hands first and then apply to face.
- Wash hands after application to avoid accidental exposure to eyes. Children should not handle repellents. Instead, adults should apply repellents to their own hands first, and then gently spread on the child's exposed skin. Avoid applying directly to children's hands.
- Use just enough repellent to cover exposed skin or clothing. Heavy application and saturation are generally unnecessary for effectiveness. If biting insects do not respond to a thin film of repellent, apply a bit more.
- After returning indoors, wash treated skin with soap and water or bathe. This is particularly important when repellents are used repeatedly in a day or on consecutive days.
- Wash treated clothing before wearing it again. This precaution may vary with different repellents—check the product label.

If a traveler experiences a rash or other reaction, such as itching or swelling, from an insect repellent, the repellent should be discontinued and washed off with mild soap and water, and a local poison-control center should be called for further guidance. Travelers seeking health care because of the repellent should take the repellent to the doctor's office and show the doctor. Permethrin should **never** be applied to skin but only to clothing, bed nets, or other fabrics as directed on the product label.

Children

Most repellents can be used on children aged >2 months. Protect infants aged <2 months from mosquitoes by using an infant carrier draped with mosquito netting with an elastic edge for a

tight fit. Products containing OLE specify that they should not be used on children aged <3 years. Other than the safety tips listed above, EPA does not recommend any additional precautions for using registered repellents on children or on pregnant or lactating women.

Useful Links

- Using Insect Repellents Safely (EPA): <http://epa.gov/pesticides/insect/safe.htm>
- Insect Repellent Use and Safety (CDC): www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm
- National Pesticide Information Center: <http://npic.orst.edu/index.html>

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<http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-2-the-pre-travel-consultation/protection-against-mosquitoes-ticks-and-other-insects-and-arthropods.htm>