

LIVESAY EXPEDITIONS & ADVENTURES

Protection Against Mosquitoes, Ticks, and Other Insects and Arthropods

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Although vaccines or chemoprophylactic drugs are available to protect against some important vector-borne diseases such as yellow fever and malaria, 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, bio-availability, and compliance with medication, and no similar preventive measures exist for other mosquito-borne diseases such as dengue or chikungunya.

CDC recommends the use of products containing active ingredients that have been registered by the U.S. Environmental Protection Agency (EPA) for use as repellents applied to skin and clothing (see below). 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 Travelers' Health webpage provides alerts and information on regional disease transmission patterns and outbreak alerts (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 (e.g., dengue, chikungunya) is during daylight hours. Vectors of other diseases (e.g., malaria) are most active in twilight periods (i.e., 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 greater 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 and wearing socks and closed shoes instead of sandals may reduce risk. Repellents or insecticides such as permethrin can be applied to clothing and gear for added protection; this measure is discussed in detail below.
- **Check for ticks:** Travelers should be advised to 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 an insecticide or repellent such as permethrin. Pretreated, long-lasting bed nets can be purchased prior to traveling, or nets can be treated after purchase. The permethrin will be effective for several months if the bed net is not washed. (Long-lasting pretreated nets may be effective for much longer.)
- **Insecticides:** Aerosol insecticides, vaporizing mats and mosquito coils can help to clear rooms

or areas of mosquitoes; however, some products available internationally may contain pesticides that are not registered in the United States. Insecticides 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.**

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 avoid 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, aka 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*** or **PMD** (chemical name: *para*-menthane-3,8-diol) the synthesized version of oil of lemon eucalyptus. Products containing OLE and PMD include but are not limited to Repel.
- **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.

**Note:* This recommendation refers to EPA-registered repellent products containing the active ingredient oil of lemon eucalyptus (or PMD). “Pure” oil of lemon eucalyptus (e.g., essential oil) is not the same product and has not received similar, validated testing for safety and efficacy, is not registered with EPA as an insect repellent, and is not covered by this recommendation.

EPA characterizes the active ingredients DEET and picaridin as “conventional repellents” and oil of lemon eucalyptus, 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, 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 $\leq 10\%$ active ingredient may offer only limited protection, often from 1–2 hours.
- Products that offer **sustained release or controlled release (i.e., micro-encapsulated) formulations, even with lower active ingredient concentrations, may provide longer protection times.**
- Studies suggest that concentrations of DEET above $\sim 50\%$ do not offer a marked increase in protection time against mosquitoes (i.e., DEET efficacy tends to plateau at around 50%).
- Regardless of what product is used, if travelers start to get mosquito bites they should reapply the repellent according to the label instructions or leave the area with biting insects if possible.

Repellents should be purchased before traveling and can be found 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 above.

Repellents and Sunscreen

Repellents that are applied according to label instructions may be used with sunscreen with no reduction in repellent activity. Products that combine sunscreen and repellent are not recommended, because sunscreen may need to be reapplied with greater frequency and in greater amounts than are needed to provide protection from biting insects. **In general, the recommendation is to apply sunscreen first, before applying the repellent.**

Repellents/Insecticides for Use On Clothing

- **Clothing, 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 and repellent. Permethrin-treated clothing repels and kills ticks, mosquitoes, and other arthropods. Clothing and other items must be treated several days 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 (e.g., products from Buzz Off/Insect Shield).
- Permethrin-treated materials retain repellency/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 (e.g., DEET) provides protection from biting arthropods but will not last through washing and will require more frequent reapplications.

Precautions when Using Insect Repellents

- Apply repellents only to exposed skin and/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.
- Do not allow children to handle repellents. When using on children, adults should apply repellents to their hands first, and then put it on the child. It may be advisable to avoid applying to children's hands.
- Use just enough repellent to cover exposed skin and/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. Also, wash treated clothing before wearing it again. (This precaution may vary with different repellents—

check the product label.)

- If anyone experiences a rash or other bad reaction from an insect repellent, the repellent use should be discontinued, the repellent should be washed off with mild soap and water, and a local poison control center should be called for further guidance. If seeking health care because of the repellent, 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 >2 months of age.
- Protect infants <2 months of age from biting mosquitoes by using an infant carrier draped with mosquito netting with an elastic edge for a tight fit.
- Products containing oil of lemon eucalyptus specify that they should not be used on children <3 years of age.
- 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

- U.S. Environmental Protection Agency. How to Use Insect Repellents Safely; [updated 2007 July 5; cited 2008 Nov 29]. Available from: www.epa.gov/pesticides/health/mosquitoes/insectrp.htm.
- Centers for Disease Control and Prevention. Insect Repellent Use and Safety; [updated 2008 May 14; cited 2008 Nov 29]. Available from: www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm.
- Health Canada's Pest Management Regulatory Agency. Safety Tips on Using Personal Insect Repellents; [updated 2004 September 17; cited 2008 Nov 29]. Available from: www.pmra-arla.gc.ca/english/consum/insectrepellents-e.html.

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