

# The Medical Letter<sup>®</sup>

## on Drugs and Therapeutics

Volume 58

July 4, 2016

ISSUE No.

1498

### IN THIS ISSUE

Insect Repellents..... p 83

## Important Copyright Message

### FORWARDING OR COPYING IS A VIOLATION OF U.S. AND INTERNATIONAL COPYRIGHT LAWS

The Medical Letter, Inc. publications are protected by U.S. and international copyright laws. Forwarding, copying or any distribution of this material is prohibited.

Sharing a password with a non-subscriber or otherwise making the contents of this site available to third parties is strictly prohibited.

By accessing and reading the attached content I agree to comply with U.S. and international copyright laws and these terms and conditions of The Medical Letter, Inc.

For further information click: [Subscriptions](#), [Site Licenses](#), [Reprints](#)  
or call customer service at: 800-211-2769

# The Medical Letter®

## on Drugs and Therapeutics

Volume 58 (Issue 1498)

July 4, 2016

Take CME Exams

### ▶ Insect Repellents

Use of insect repellents is strongly recommended by the CDC and the EPA to prevent Zika virus infection<sup>1,2</sup> and other mosquito- and tickborne diseases.<sup>3</sup> Mosquitoes can transmit chikungunya, dengue, West Nile, and yellow fever viruses, and malaria. Ticks can transmit Lyme disease and rickettsial diseases such as Rocky Mountain spotted fever.

**DEET** – The topical insect repellent with the best documented effectiveness against mosquitoes is *N,N*-diethyl-*m*-toluamide (DEET).<sup>4,5</sup> Applied on exposed skin, DEET also repels ticks, chiggers, fleas, gnats, and some flies. DEET is available in concentrations of 5-100%. In general, higher concentrations provide longer-lasting protection,<sup>6</sup> but increasing the concentration above 50% has not been shown to improve efficacy. Long-acting polymer-based or liposomal DEET formulations containing concentrations of 30-34% have

been shown to protect against mosquitoes for up to 12 hours. The CDC recommends using concentrations ≥20% for protection against ticks.

**Adverse Effects** – Toxic and allergic reactions to DEET have been uncommon, and serious adverse effects are rare. Rashes ranging from mild irritation to urticaria and bullous eruptions have been reported. Patients find that some DEET formulations feel uncomfortably oily or sticky on their skin. DEET can damage clothes made from synthetic fibers and plastics on eyeglass frames and watch crystals.

**Children** – According to the CDC, DEET is safe for children and infants >2 months old; the American Academy of Pediatrics recommends using formulations containing concentrations of 10-30% in children. Toxic encephalopathy has occurred, usually with prolonged or excessive use in infants and children that sometimes included ingestion of the product.

Table 1. Some Insect Repellents

Repellent	Brand Name	Formulation	Duration of Protection <sup>1</sup>		Cost (Size) <sup>2</sup>
			Mosquitoes	Ticks	
DEET	<i>Cutter Skinsations</i>	7% pump spray	1-3 hrs <sup>3</sup>	6 hrs <sup>3</sup>	\$6.40 (7.5 oz)
	<i>Repel Scented Family</i>	15% aerosol spray	5-8 hrs <sup>3</sup>	8.5 hrs <sup>3</sup>	6.86 (6.5 oz)
	<i>Off Deep Woods VIII</i>	25% aerosol spray	8 hrs <sup>3</sup>	5 hrs <sup>3</sup>	7.38 (6 oz)
	<i>Sawyer Ultra 30 Liposome Controlled Release</i>	30% lotion	11 hrs	N.A.	8.49 (4 oz)
	<i>Ultrathon<sup>4</sup></i>	34% lotion	12 hrs	N.A.	6.99 (2 oz)
Picaridin	<i>Cutter Advanced</i>	5.75% wipes	8 hrs	5 hrs	5.99 (18 wipes)
	<i>Avon Skin So Soft Bug Guard Plus Picaridin</i>	10% aerosol spray	8 hrs	12 hrs	6.99 (4 oz)
	<i>Natrapel 8 hour</i>	20% pump spray	8 hrs	8 hrs	5.59 (3.4 oz)
	<i>IR3535</i>	7.5% lotion	2 hrs	2 hrs	10.89 (4 oz)
IR3535	<i>Avon Skin So Soft Bug Guard Plus IR3535<sup>5</sup></i>	20% pump spray	8 hrs	8 hrs	4.99 (5 oz)
	<i>Coleman Skin Smart</i>	20% pump spray	8 hrs	8 hrs	4.99 (5 oz)
Oil of lemon eucalyptus	<i>Coleman Botanicals</i>	30% pump spray	6 hrs	N.A.	8.94 (4 oz)
	<i>Repel Lemon Eucalyptus</i>	30% pump spray	7-8 hrs <sup>3</sup>	7 hrs <sup>3</sup>	4.99 (4 oz)
Permethrin	<i>Sawyer Premium</i>	0.5% pump spray	–	–	14.99 (24 oz)
	<i>Permethrin Clothing</i>	0.5% aerosol spray	–	–	7.42 (6.5 oz)
	<i>Repel Permethrin Clothing and Gear</i>	0.5% aerosol spray	–	–	7.42 (6.5 oz)

N.A. = not available

1. For repellents applied to exposed skin, according to protection times approved by the EPA for product labels. Available at: [www.epa.gov/insect-repellents/find-insect-repellent-right-you](http://www.epa.gov/insect-repellents/find-insect-repellent-right-you). Accessed June 23, 2016. Duration of protection may be affected by ambient temperature, activity level, amount of perspiration, exposure to water, and other factors.

2. Cost at amazon.com (June 23, 2016).

3. Duration of protection against *Aedes* and *Culex* mosquitoes and deer ticks according to the results of laboratory tests performed by Consumer Reports. Available at: [www.consumerreports.org/cro/health/beauty-personal-care/insect-repellent/insect-repellent-ratings/ratings-overview.htm](http://www.consumerreports.org/cro/health/beauty-personal-care/insect-repellent/insect-repellent-ratings/ratings-overview.htm). Accessed June 23, 2016.

4. Long-acting polymer-based formulation developed for the US military.

5. Contains IR3535 combined with sunscreen; products that contain both an insect repellent and a sunscreen are not recommended because the sunscreen may need to be reapplied more often and in greater amounts than the repellent.

**PICARIDIN** — Picaridin provides protection against mosquitoes, ticks, flies, fleas, and chiggers. It is available in concentrations of 5-20%; higher concentrations typically provide longer durations of protection.<sup>7</sup> In a controlled field trial, picaridin 19.2% prevented mosquito bites as effectively as a long-acting 33% DEET formulation used by the US military.<sup>8</sup> Picaridin 20% can provide 8-10 hours of protection against tick bites.<sup>9</sup>

**Adverse Effects** — Picaridin can cause skin and eye irritation, but it appears to be better tolerated on the skin than DEET. It is odorless, non-greasy, and does not damage fabric or plastic; it can discolor leather and vinyl.

**Children** — According to the American Academy of Pediatrics, formulations of picaridin containing concentrations of 5-10% can be used on children as an alternative to DEET.

**IR3535** — IR3535 repels mosquitoes, deer ticks, and flies. It is available in concentrations of 7.5% and 20% in the US. Concentrations  $\geq$ 10% have been found to be effective against mosquito bites for several hours.<sup>10</sup> Two studies found the 7.5% concentration to be ineffective.<sup>6,11</sup>

**OIL OF LEMON EUCALYPTUS (OLE)** — OLE (*p*-menthane-3,8-diol [PMD]), which repels mosquitoes, flies, and gnats, occurs naturally in the lemon eucalyptus plant. It is chemically synthesized for commercial use. In field studies against malaria-transmitting mosquitoes, OLE provided up to 6 hours of protection against mosquito bites.<sup>10</sup> It is less effective than DEET or picaridin against ticks.<sup>9</sup> OLE can be irritating to the eyes.

**Children** — OLE products should not be used on children <3 years old.

**CITRONELLA** — Citronella oil-based insect repellents provide short-term protection against mosquitoes, but they are probably not effective against ticks. In laboratory studies, various concentrations of citronella oil were much less effective than DEET against mosquito bites; the protection times for citronella oil ranged from 1.5 to 5 hours.<sup>12</sup>

**ESSENTIAL OILS** — Essential oils obtained from raw botanical material, including clove, geraniol, and patchouli, provide limited and variable protection against mosquitoes. High concentrations may be more effective, but can be irritating to the skin.<sup>13</sup>

**SUNSCREEN AND INSECT REPELLENTS** — Insect repellents can be used with sunscreens; the repellent

should be applied after the sunscreen. Applying DEET after sunscreen has been shown to reduce the SPF of the sunscreen, but applying sunscreen second may increase absorption of DEET. The CDC does not recommend use of products that combine a sunscreen with an insect repellent because the sunscreen may need to be reapplied more often and in greater amounts than the repellent.

**PERMETHRIN** — A synthetic pyrethroid contact insecticide, permethrin is used on clothing, mosquito nets, tents, and sleeping bags to repel and kill mosquitoes and ticks. Sprayed on clothing, it remains active for several weeks through multiple launderings with minimal transfer to the skin. An indoor laboratory study found that subjects wearing permethrin-treated sneakers and socks were 73.6 times less likely to be bitten by a tick than those wearing untreated footwear.<sup>14</sup> Studies in outdoor workers in North Carolina wearing commercially available permethrin-impregnated uniforms found that the clothing protected against mosquito and tick bites for at least 1 year.<sup>15,16</sup>

**PREGNANCY** — The CDC considers EPA-registered formulations of DEET, picaridin, IR3535, and OLE safe for use during pregnancy.<sup>3</sup> According to the EPA, there is no evidence that exposure to permethrin results in reproductive effects in pregnant or nursing women or developmental adverse effects in their children.<sup>17</sup>

**CONCLUSION** — DEET-containing insect repellents can prevent mosquito and tick bites and are generally safe. Picaridin appears to be as effective as equivalent concentrations of DEET and may be better tolerated. Wearing protective clothing treated with the insecticide permethrin in addition to using DEET or picaridin on exposed skin may provide the best protection. ■

1. LH Chen and DH Hamer. Zika virus: rapid spread in the Western Hemisphere. *Ann Intern Med* 2016; 164:613.
2. E Dirlilikov et al. Update: Ongoing Zika virus transmission — Puerto Rico, November 1, 2015-April 14, 2016. *MMWR Morb Mortal Wkly Rep* 2016; 65:451.
3. CDC/EPA. Joint statement on insect repellents from the Environmental Protection Agency and the Centers for Disease Control and Prevention. July 17, 2014. Available at: [https://www.epa.gov/sites/production/files/2014-07/documents/joint-epa-cdc-stmnt\\_3.pdf](https://www.epa.gov/sites/production/files/2014-07/documents/joint-epa-cdc-stmnt_3.pdf). Accessed June 23, 2016.
4. E Lupi et al. The efficacy of repellents against *Aedes*, *Anopheles*, *Culex* and *Ixodes* spp. — a literature review. *Travel Med Infect Dis* 2013; 11:374.
5. Advice for travelers. *Med Lett Drugs Ther* 2015; 57:52.
6. MS Fradin and JF Day. Comparative efficacy of insect repellents against mosquito bites. *N Engl J Med* 2002; 347:13.
7. Picaridin — a new insect repellent. *Med Lett Drugs Ther* 2005; 47:46.

8. SP Frances et al. Field evaluation of repellent formulations against daytime and nighttime biting mosquitoes in a tropical rainforest in northern Australia. *J Med Entomol* 2002; 39:541.
9. F Pages et al. Tick repellents for human use: prevention of tick bites and tick-borne diseases. *Vector Borne Zoonotic Dis* 2014; 14:85.
10. LI Goodyer et al. Expert review of the evidence base for arthropod bite avoidance. *J Travel Med* 2010; 17:182.
11. SP Frances et al. Comparative field evaluation of repellent formulations containing deet and IR3535 against mosquitoes in Queensland, Australia. *J Am Mosq Control Assoc* 2009; 25:511.
12. C Kongkaew et al. Effectiveness of citronella preparations in preventing mosquito bites: systematic review of controlled laboratory experimental studies. *Trop Med Int Health* 2011; 16:802.
13. Y Trongtokit et al. Comparative repellency of 38 essential oils against mosquito bites. *Phytother Res* 2005; 19:303.
14. NJ Miller et al. Tick bite protection with permethrin-treated summer-weight clothing. *J Med Entomol* 2011; 48:327.
15. MF Vaughn et al. Long-lasting permethrin impregnated uniforms: a randomized-controlled trial for tick bite prevention. *Am J Prev Med* 2014; 46:473.
16. B Londono-Renteria et al. Long-lasting permethrin-impregnated clothing protects against mosquito bites in outdoor workers. *Am J Trop Med Hyg* 2015; 93:869.
17. US Environmental Protection Agency. Repellent-treated clothing. Last updated March 29, 2016. Available at: <https://www.epa.gov/insect-repellents/repellent-treated-clothing>. Accessed June 23, 2016.

Follow us on Twitter  Like us on Facebook 

**PRESIDENT:** Mark Abramowicz, M.D.; **VICE PRESIDENT AND EXECUTIVE EDITOR:** Gianna Zuccotti, M.D., M.P.H., F.A.C.P., Harvard Medical School; **EDITOR IN CHIEF:** Jean-Marie Pflomm, Pharm.D.; **ASSOCIATE EDITORS:** Susan M. Daron, Pharm.D., Amy Faucard, MLS, Corinne Z. Morrison, Pharm.D., Michael P. Viscusi, Pharm.D.; **CONSULTING EDITORS:** Brinda M. Shah, Pharm.D., F. Peter Swanson, M.D.

**CONTRIBUTING EDITORS:** Carl W. Bazil, M.D., Ph.D., Columbia University College of Physicians and Surgeons; Vanessa K. Dalton, M.D., M.P.H., University of Michigan Medical School; Eric J. Epstein, M.D., Albert Einstein College of Medicine; Jane P. Gagliardi, M.D., M.H.S., F.A.C.P., Duke University School of Medicine; David N. Juurlink, BPhm, M.D., Ph.D., Sunnybrook Health Sciences Centre; Richard B. Kim, M.D., University of Western Ontario; Franco M. Muggia, M.D., New York University Medical Center; Sandip K. Mukherjee, M.D., F.A.C.C., Yale School of Medicine; Dan M. Roden, M.D., Vanderbilt University School of Medicine; Esperance A.K. Schaefer, M.D., M.P.H., Harvard Medical School; F. Estelle R. Simons, M.D., University of Manitoba; Neal H. Steigbigel, M.D., New York University School of Medicine; Arthur M. F. Yee, M.D., Ph.D., F.A.C.R., Weill Medical College of Cornell University

**MANAGING EDITOR:** Susie Wong; **ASSISTANT MANAGING EDITOR:** Liz Donohue; **EDITORIAL ASSISTANT:** Cheryl Brown

**EXECUTIVE DIRECTOR OF SALES:** Gene Carbona; **FULLFILLMENT AND SYSTEMS MANAGER:** Cristine Romatowski; **EXECUTIVE DIRECTOR OF MARKETING AND COMMUNICATIONS:** Joanne F. Valentino; **VICE PRESIDENT AND PUBLISHER:** Yosef Wissner-Levy

Founded in 1959 by  
Arthur Kallet and Harold Aaron, M.D.

**Copyright and Disclaimer:** The Medical Letter, Inc. is an independent nonprofit organization that provides healthcare professionals with unbiased drug prescribing recommendations. The editorial process used for its publications relies on a review of published and unpublished literature, with an emphasis on controlled clinical trials, and on the opinions of its consultants. The Medical Letter, Inc. is supported solely by subscription fees and accepts no advertising, grants, or donations. No part of the material may be reproduced or transmitted by any process in whole or in part without prior permission in writing. The editors do not warrant that all the material in this publication is accurate and complete in every respect. The editors shall not be held responsible for any damage resulting from any error, inaccuracy, or omission.

#### Subscription Services

**Address:**  
The Medical Letter, Inc.  
145 Huguenot St. Ste. 312  
New Rochelle, NY 10801-7537  
[www.medicalletter.org](http://www.medicalletter.org)

**Customer Service:**  
Call: 800-211-2769 or 914-235-0500  
Fax: 914-632-1733  
E-mail: [custserv@medicalletter.org](mailto:custserv@medicalletter.org)

**Permissions:**  
To reproduce any portion of this issue, please e-mail your request to: [permissions@medicalletter.org](mailto:permissions@medicalletter.org)

**Subscriptions (US):**  
1 year - \$129; 2 years - \$232;  
3 years - \$345. \$65 per year  
for students, interns, residents, and  
fellows in the US and Canada.  
Reprints - \$12 each.

**Site License Inquiries:**  
E-mail: [info@medicalletter.org](mailto:info@medicalletter.org)  
Call: 800-211-2769 ext. 315  
Special rates available for bulk  
subscriptions.

