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Fight the Bite: Methods to Reduce the Risk of Mosquito-Borne Diseases

Avoiding mosquito bites altogether is the best way to protect yourself from mosquito-borne diseases such as West Nile Virus (WNV). Avoidance strategies include wearing skin products and clothing that do not attract mosquitoes, staying indoors during peak biting times, eliminating containers holding water where mosquitoes may breed, and using mosquito repellents when outdoors.

The factors that attract mosquitoes to a host are complex and are not fully understood. Mosquitoes use visual, thermal (heat), and olfactory cues to locate a host. Of these, olfactory cues (smell) are probably most important. For daytime-biting mosquitoes, visual cues such as dark-colored clothing and motion may begin orientation toward the person. These visual cues seem to be important for in-flight orientation, particularly over long ranges. Wearing light-colored loose-fitting clothing helps reduce mosquito bites by eliminating these cues. Olfactory cues become more important as a mosquito nears its host. Mosquitoes are especially attracted to people wearing scented products such as after-shave and perfume.

For mosquitoes to breed, specific conditions must be present. A mosquito's life cycle consists of four stages (egg, larva, pupa, and adult). Mosquitoes must lay their eggs in still water, or on damp soil that will soon be flooded with water. Eggs can hatch into larvae in 24-48 hours. The larvae and pupae must have standing water to survive, and this stage will typically take 5 to 18 days before the production of an adult mosquito. Many mosquitoes, including those that carry WNV, do not fly far from where they breed, so emptying water-filled flowerpots, old tires, gutters and other containers and keeping ditches cleaned out so water can flow can reduce mosquito numbers and help you avoid mosquito bites.

When you must be outdoors, an insect repellent is often the best protection from mosquito bites. The ideal agent would repel many species of biting ticks and flies, remain effective for at least 8 hours, cause no irritation to the skin or mucous membranes, cause no systemic toxicity, resist abrasion and rub-off, and be greaseless and odorless. No available insect repellent meets all of these criteria. The following information describes some of the more common mosquito repellent products.

DEET-based products

N, N-diethyl-3-methylbenzamide (DEET) is the most effective and best studied insect repellent currently on the market. Depending on the situation, DEET can provide two to eight hours of protection. "… (T)his repellent has been subjected to more scientific and toxicologic scrutiny than any other repellent substance. …DEET has a remarkable safety profile after 40 years of use and nearly 8 billion human applications. Fewer than 50 cases of serious toxic effects have been documented in the medical literature since 1960, and three quarters of them resolved without sequelae. Many of these cases of toxic effects involved long-term, heavy, frequent, or whole-body application of DEET. No correlation has been found between the concentration of DEET used and the risk of toxic effects." (Fradin and Day, 2002) For casual use, a high concentration of DEET is not needed; products with 10% to 30% DEET will provide adequate protection under most conditions. The American Academy of Pediatrics recommends that repellents used on children contain no more than 10% DEET. Products containing DEET currently are available to the public in a variety of liquids, lotions, sprays, and impregnated materials (e.g., wrist bands). A list of some of these products can be found at http://www.acponline.org/journals/annals/01jun98/mosqutb1.htm. It should be noted that materials impregnated with DEET will only repel mosquitoes from landing close to where the impregnated material is worn, so wrist bands impregnated with DEET may prevent mosquitoes from landing on the arms, but not the legs. Questions about the safety of DEET may be addressed to the EPA-sponsored National Pesticide Telecommunications Network, available by telephone every day from 6:30 a.m. to 4:30 p.m. Pacific Standard Time at 800-858-7378 or on the World Wide Web at http://www.ace.orst.edu/info/nptn/.

Plant-derived repellents

Thousands of plants have been tested as potential sources of insect repellents. With one exception, none of the plant-derived chemicals tested to date demonstrate the broad effectiveness and duration of DEET, and only a few actually show repellent activity. Plants whose essential oils have been reported to have repellent activity include citronella, cedar, verbena, pennyroyal, geranium, lavender, pine, cajuput, cinnamon, rosemary, basil, thyme, allspice, garlic, and peppermint. A partial list of products containing some of these different ingredients is available at http://www.acponline.org/journals/annals/01jun98/mosqutb5.gif. When tested, most of these essential oils gave only short-term protection, usually lasting less than 2 hours.

Bite Blocker contains soybean oil, geranium oil, and coconut oil. This product does appear to provide as good or better protection from mosquito bites as compared with DEET-based repellents. Studies conducted at the University of Guelph, Ontario, Canada, showed that this product gave more than 97% protection against *Aedes* mosquitoes under field conditions, even 3.5 hours after application. During the same period, a 6.65% DEET-based spray afforded 86% protection, and Avon Skin-So-Soft citronella-based repellent gave only 40% protection. (Fradin 1998)

Citronella is a common and popular ingredient in many repellents, including Buzz Away, Skin-So-Soft Bug Guard, Natrapel, Herbal Armor, and Green Ban. It is derived from a lemon-scented grass and can be found in oils, sprays and candles. Studies have shown that citronella oil protects against most mosquito bites in the first 30 to 40 minutes after application, but its effectiveness diminishes quickly after that and is gone in two hours. Because of this, citronella-based products should be replenished every two hours to be most effective. Citronella candles and incense have been promoted as an effective way to repel mosquitoes in the backyard. However, the efficacy of citronella candles and incense and plain candles do not differ. (Fradin 1998) The ability of plain candles to decrease mosquito biting may result from their action as a decoy source of warmth, moisture, and carbon dioxide.

Skin-So-Soft bath oil received a lot of attention several years ago when some consumers reported it to be effective as a mosquito repellent. When tested under laboratory conditions, this product provided limited protection from mosquito bites. Avon now markets products under the Skin-So-Soft label that contain the EPA-recognized repellent, citronella oil. These products should also be replenished frequently to be most effective.

Permethrin

Permethrin is a human-made synthetic pyrethroid, a powerful, rapidly acting insecticide, originally derived from the crushed and dried flowers of the daisy *Chrysanthemum cinerariifolium.* It is not actually a repellent, as it does not repel insects but works as a contact insecticide, causing nervous system toxicity that leads to the death or "knockdown" of the insect. The chemical is effective against mosquitoes, flies, ticks, and chiggers. Permethrin has low toxicity in mammals, is poorly absorbed through the skin, and is rapidly inactivated.

Permethrin should be applied directly to clothing or other fabrics, not to skin. The spray form is resistant to degradation by heat or sun, and maintains its potency for at least 2 weeks, even through several launderings. The combination of permethrin-treated clothing and skin application of a DEET-based repellent creates a formidable barrier against mosquito bites. A partial list of products containing permethrin are listed at http://www.acponline.org/journals/annals/01jun98/mosqutb5.gif.

The table below, taken from http://healthlink.mcw.edu/article/1026490366.html, shows some common products, along with their active ingredients and the average amount of time that each product repelled mosquitoes.

Product Name	Active Ingredients	Length of Protection
OFF! Deep Woods -	(DEET 23.8%)	5.0 hours
Sawyer Controlled Release -	(DEET 20%)	3.9 hours
OFF! Skintastic -	(DEET 6.65%)	1.9 hours
Bite Blocker for Kids -	(Soybean Oil 2%)	1.6 hours
OFF! Skintastic for Kids -	(DEET 4.75%)	1.5 hours
Skin-So-Soft Bug Guard Plus -	(IR3535 7.5%)	22.9 min
Natrapel -	(Citronella 10%)	19.7 min
Herbal Armor -	(Citronella 12%; peppermint oil 2.5%; other <2%)	18.9 min
Green Ban for People -	(Citronella 10%; peppermint oil 2%)	14 min
Buzz Away -	(Citronella 5%)	13.5 min
Skin-So-Soft Bath Oil -	Not Known	9.6 min
Skin-So-Soft Moisturizing Suncare -	(Citronella 0.05%)	2.8 min
Gone Original Wristband -	(DEET 9.5%)	18 sec

Safety Guidelines

Whichever product is used to prevent mosquito bites, it is important to read the label and apply the product correctly. The Environmental Protection Agency (EPA)'s Office of Pesticide Programs (http://www.epa.gov/pesticides/factsheets/insectrp.htm#using) recommends following these guidelines to ensure safety when using insect repellents on adults or children:

- Read the entire product label before applying repellent to be sure you are following the directions. Even if you have read it before, do not trust your memory. Read it again.
- Apply repellent only to exposed skin, as indicated by the label. It is important to remember to apply repellent to all areas of exposed skin because mosquitoes will bite untreated skin that is only a few centimeters away from repellent-covered skin.
- Do not go overboard with repellent. Saturation is not necessary. Use just enough to cover exposed skin.
- Do not use repellents on cuts or otherwise irritated skin.
- Do not spray repellent directly on the face. Instead, spray it on your hands first and then use your hands to apply it to the face. Use sparingly on the face and keep repellent away from eyes and mouth. After applying the repellent, be sure to wash your hands.
- Do not apply repellent to children's hands at all. Use your own hands, rather than a spray, to put repellent on a child. After applying the repellent to the child, be sure to wash your hands.
- Do not spray repellent in enclosed areas or near food.
- Once back inside, wash treated skin with soap and water as soon as possible, especially if you have made more than one application

or have used repellent on consecutive days. If you have sprayed repellent (not permethrin) on your clothing, you should wash it before wearing it again.

- If you think you or your child might be having a reaction to a repellent, wash it off immediately, then call a local poison control center.

Repelling Devices

Ultrasonic devices, bug "zappers," purple martin houses, and bat houses are not effective against mosquitoes. The Federal Trade Commission (FTC) has stated that ultrasonic devices do not repel insects (http://www.ipm.iastate.edu/ipm/hortnews/2001/8-24-2001/ultrasonic.html). Bug zappers tend to kill harmless or beneficial insects such as dragonflies, which will eat mosquitoes, and bees, which are vital for plant pollination (http://www.ipm.iastate.edu/ipm/hortnews/1996/6-14-1996/bugzapper.html). Purple martins, dragonflies, and bats do not eat enough mosquitoes to effectively reduce mosquito populations. Bats should not be encouraged to live near human dwellings because of the potential problem with bat rabies. Mosquito traps, such as the Mosquito Magnet, which have had a lot of press as a means of reducing mosquito bites without the use of repellents, have had their effectiveness somewhat overstated. The American Mosquito Control Association (AMCA) states that "these devices will, indeed, trap and kill measurable numbers of mosquitoes. Whether this will produce a noticeable reduction in the mosquito population in your case will depend upon a number of factors, e.g. your tolerance level, absolute mosquito population size, proximity, size and type of breeding habitat producing re-infestation, wind velocity and direction, and species of mosquito present, among many other things. Depending upon their placement, wind direction, and trapping efficiency, traps may actually draw more mosquitoes into your area than they can possibly catch. Thus, the homeowner must still use repellents and practice source reduction methods as adjuncts to realize any measure of relief."

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Written by Rosmarie Kelly, Ph.D., M.P.H.

Cardiac Adverse Events Prompt New Screening Guidelines for Smallpox Vaccination

Previously unanticipated cardiac adverse events following smallpox vaccination have prompted new more restrictive guidelines for screening potential vaccine recipients.

Inflammation of the heart (myocarditis), the membrane covering the heart (pericarditis), and a combination of these two conditions (myopericarditis) are serious and potentially life-threatening events that have followed smallpox vaccination of both military and civilians. These events had been associated previously with vaccine strains used in Europe, but had not been associated until recently with the vaccine strain in use in the US. Susceptibility to these events may be universal, but persons with pre-existing cardiac disease are believed to be most at risk for serious outcomes.

Several cases of cardiac ischemic events (myocardial infarction, angina) have also been observed following smallpox vaccination, but whether vaccination contributed to these events is not clear.

In response, the CDC has recommended that persons with pre-existing heart disease or significant cardiac risk factors not receive the smallpox vaccine at this time (http://www.bt.cdc.gov/agent/smallpox/vaccination/pdf/heartproblems-vis.pdf). The Georgia Division of Public Health has accepted the CDC recommendations and will be implementing them with some modification, as below. The screening criteria applied in Georgia are slightly more restrictive than those recommended by CDC to assure the greatest possible margin of safety while research on the newly recognized adverse events continues.

Cardiac exclusion criteria for Phase 1 smallpox vaccination in Georgia

1) Any diagnosed heart condition or ischemic cardiovascular condition, with or without symptoms, such as:
   a. Previous myocardial infarction
   b. Angina
   c. Congestive heart failure
   d. Cardiomyopathy
   e. Stroke or transient ischemic attack
   f. Other heart conditions under the care of a doctor (including valve disease and dysrhythmias)
2) History of high blood pressure
3) History of diabetes
4) Two or more of the following cardiac risk factors:
   a. High blood cholesterol
   b. Smoking
   c. An immediate family member with onset of a heart condition before age 50
   d. Obesity

Identification of unanticipated cardiac adverse events was possible through intensive surveillance and reporting of all serious medical events following smallpox vaccination. This surveillance continues to inform the program and help minimize the risk to vaccine recipients. **Any adverse event following smallpox vaccination in Georgia should be immediately reported to the local District Health Office, or by calling 1-866-PUB-HLTH (1-866-782-4584).**

This article was written by W. Gary Hlady, M.D., M.S.

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Reported Cases of Selected Notifiable Diseases in Georgia Profile* for March 2003

Selected Notifiable Diseases	Total Reported for March 2003	Previous 3 Months Total Ending in March			Previous 12 Months Total Ending in March		
	2003	2001	2002	2003	2001	2002	2003
Campylobacteriosis	30	132	115	92	637	623	641
Chlamydia trachomatis	2205	8427	8729	8112	30746	32987	34162
Cryptosporidiosis	12	32	28	23	179	158	118
E. coli O157:H7	1	2	7	4	43	50	44
Giardiasis	44	230	181	178	1146	912	923
Gonorrhea	1192	4504	4457	4091	19489	18297	18435
Haemophilus influenzae (invasive)	7	30	29	14	90	109	69
Hepatitis A (acute)	24	165	150	77	484	915	436
Hepatitis B (acute)	28	105	105	60	392	434	439
Legionellosis	0	3	3	5	11	12	21
Lyme Disease	0	0	1	1	0	2	2
Meningococcal Disease (invasive)	2	22	8	11	53	43	35
Mumps	0	5	0	0	5	4	2
Pertussis	0	5	5	2	39	23	26
Rubella	0	0	0	0	1	0	0
Salmonellosis	62	211	228	199	1670	1738	1923
Shigellosis	93	71	260	328	330	941	1895
Syphilis - Primary	3	29	33	18	117	100	99
Syphilis - Secondary	20	72	58	79	277	290	346
Syphilis - Early Latent	36	162	181	138	558	699	644
Syphilis - Other**	29	236	213	129	787	841	644
Syphilis - Congenital	0	6	5	1	21	23	9
Tuberculosis	29	84	92	97	664	570	525

* The cumulative numbers in the above table reflect the date the disease was first diagnosed rather than the date the report was received at the state office, and therefore are subject to change over time due to late reporting. The 3 month delay in the disease profile for a given month is designed to minimize any changes that may occur. This method of summarizing data is expected to provide a better overall measure of disease trends and patterns in Georgia.

** Other syphilis includes latent (unknown duration), late latent, late with symptomatic manifestations, and neurosyphilis.

AIDS Profile Update

Report Period	Total Cases Reported*			Percent	Risk Group Distribution (%)						Race Distribution (%)		
	<13yrs	>=13yrs	Total	Female	MSM	IDU	MSM&IDU	HS	Blood	Unknown	White	Black	Other
Latest 12 Months:													
05/02-04/03	1	1,328	1,329	26.4	33.1	7.6	1.9	12.7	1.7	43.1	18.3	76.4	5.3
Five Years Ago:													
05/98-04/99	12	1,371	1,383	21.9	37.9	16.2	5.1	18.9	1.6	20.3	22.1	75.7	2.2
Cumulative:													
07/81-04/03	211	26,020	26,231	17.8	47.3	17.2	5.3	13.6	1.9	14.7	33.6	63.9	2.5

MSM - Men having sex with men **IDU - Injection drug users** **HS - Heterosexual**

* Case totals are accumulated by date of report to the Epidemiology Section