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Eastern Equine Encephalitis in New Hampshire, 2009

Disease description and transmission
Eastern equine encephalitis (EEE) is a mosquito-spread disease of birds that sometimes is transmitted (via mosquito bite) to horses and people. The risk of serious injury or death is high for those who become sick with the disease.

In 2005, there were 21 human cases of EEE in the United States. New Hampshire led the nation with seven cases and two deaths. Florida had five cases, Massachusetts four, Alabama two, and South Carolina, Louisiana and Georgia one each. The number of N.H. cases has gone down since then.

	Number of New Hampshire EEE Cases			No. of Mosquito
Year	Humans	Other Mammals	Birds	Groups Testing Positive
1982	0	several equines	unknown	none tested
2004	1	3 equines	3 emus	19
2005	7	9 eq. 5 others	54	15
2006	0	1 equine	5	40
2007	3	1 eq. 1 alpaca	0	6
2008	0	0	1 emu	8

Some of the variability in the bird and mosquito figures above comes from changes in monitoring and testing, but overall, EEE risk has gone down from the 2005 peak.

Most of the 47 mosquito species we have in N.H. don't transmit EEE. Those that do, or might, include *Culiseta melanura,* which primarily bites birds and is the principal species that spreads EEE from bird to bird. *Coquillettidia perturbans*, which bites both birds and mammals, is the principal "bridge vector" (species carrying the disease from birds to humans or other mammals).

Several other species might be involved to some degree, including *Aedes vexans, Culex salinarius, Culex restuans, Ochlerotatus triseriatus, and Ochlerotatus canadensis.* (The virus has been found in several other mosquito species, but their ability to transmit the virus has not been proven. *Culiseta morsitans* is one example).

Getting EEE is a bit like winning the lottery. The chances of it happening are very low, but the consequences can be life-changing. The process of infection works like this:

1. A female of *C. perturbans* (or other species that bites both birds and mammals) first must bite a bird infected with EEE (male mosquitoes don't bite).
2. The blood of the infected bird contains EEE virus particles, so the mosquito biting the bird draws in the disease-causing virus with her blood meal.
3. The mosquito digests her meal for several days, and then lays her eggs. During the time that the meal is being digested and eggs laid, the virus particles move from the insect's gut to her salivary glands.
4. After the mosquito lays her eggs (if she is lucky enough to live that long), she seeks another blood meal. This time she finds you.
5. She lands, inserts her mouthparts, and injects saliva. Along with her saliva, she injects some of the virus particles. You have just been infected.

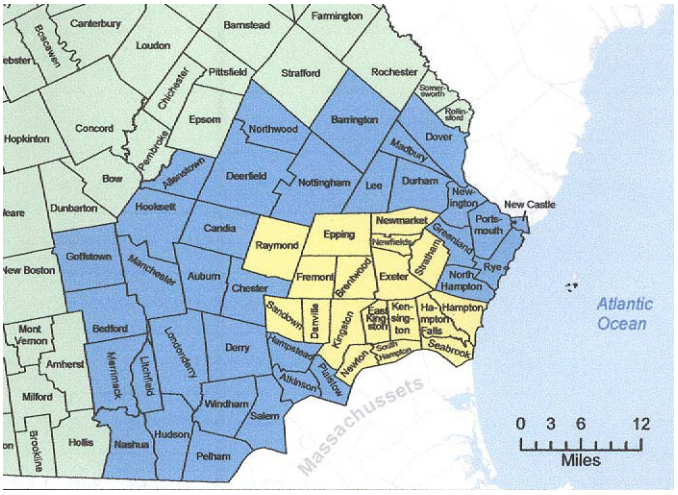
Please note: *Mosquitoes that bite EEE-infected humans or equines don't pick up enough virus particles to pass the disease along to the next human (or animal) they bite,* which makes mammals, including humans, "dead-end" hosts for EEE.

According to the Centers for Disease Control and Prevention (CDC), symptoms of EEE in people range from mild flu-like illness to inflammation of the brain, coma, and death. The human death rate is 35 percent, and about 35 percent of people who survive have lasting neurological effects of some type.

People most at risk for contracting EEE are those younger than 15 or older than 50. EEE isn't like the flu virus. You can't pass it to other people by coughing, sneezing, or shaking hands.

We don't fully understand why EEE is cyclic, but some years we have lots of cases, as in 2005. Human EEE cases typically appear in mid-August through September. If the first heavy frost comes late, the EEE disease risk could run into October.

The highest risk of EEE in New Hampshire is in Rockingham County, although southern Merrimack, southern Strafford, and eastern Hillsborough counties have an elevated risk. Essex County (Mass., which borders Rockingham Co. N.H.) also has elevated risk.



EEE can occur in areas previously thought to be lower-risk. In the map to the right, yellow indicates areas of moderate risk; blue indicates low risk, and the outlying areas (light green) have remote risk for EEE. The risk map isn't static—it changes. Throughout the season, the N.H. Department of Health and Human Services Arbovirus Program estimates risk levels and posts updates (if necessary) to their Web site. The Web address is shown at the end of this document.

Individuals can reduce their risk of contracting EEE

There are many things people can do to greatly decrease their risk of becoming infected with EEE. Basically, they all work by decreasing the chances of being bitten.

- Use insect repellent when you are outdoors, and/or wear clothing that doesn't expose lots of skin.
- Try to limit time spent outdoors within an hour or so of dusk or dawn in August and September, especially in areas with lots of mosquitoes. During the middle of the day, mosquitoes that transmit EEE aren't very active. An exception is if you walk through thick brush or woods. You disturb the vegetation on which mosquitoes rest, so they will then fly to you and bite.
- Consider trying the net-like clothing that is stiff enough to stay away from your skin. Bug Baffler http://www.bugbaffler.com/ is one example.
- Be sure that doors and windows have tight-fitting screens. Repair or replace screens that have tears or holes. This includes tents and other camping quarters.
- Limit your activity in areas near freshwater marshes with permanent vegetation, especially cattails.

Repellents (bite-preventing materials)

The term "mosquito repellent" doesn't accurately reflect how these materials work. They don't actually repel mosquitoes. They block the receptors mosquitoes use to detect appropriate hosts for them to bite. Blocking those receptors stops mosquitoes from biting, so a more accurate term might be "bite-preventing materials." Most of these products are also registered for other biting insects, and/or ticks.

We currently have three effective active ingredients for mosquito repellents:

- **DEET** The name is an acronym for the long technical name: N, N-diethyl-meta-toluamide. DEET was first developed in 1946, so we've been using it a long time. Repellents that have higher concentrations of DEET generally last longer and are more effective (to a point) than those with low concentrations. DEET should never get into mucous membranes (nose, mouth, eyes), and should never be used on infants less than two months old. Officials do not recommend using products containing more than 30 percent DEET on either children or adults. A few people are allergic to it. DEET is greasy and also dissolves some plastics.
- **Picaridin** first became available in US products in 2005. It is as effective as DEET, but appears to lack some of DEET's shortcomings. Perhaps as products containing picaridin become more widely used, some shortcomings might appear. N.H.-registered repellents containing picaridin include several brand names: Avon, Cutter, Go Ready, Natrapel, Off, and Repel.
- **IR3535** has several chemical names, including 1) ethyl butyl acetyl aminoproprionate and 2) beta-Alanine, N-acetyl-N-butyl-, ethyl ester. Tests show that it works moderately well on mosquitoes—not as well as DEET. Three manufacturers (Chattem Inc., Avon products, Sawyer products) make combination repellent & sunblock products that include this chemical and are registered in New Hampshire. The chemical was designed in the early 1970s, and has been available in Europe since the mid-1970s.

Research has shown that repellents based on natural oils or herbs are less effective than products based on picaridin or DEET. According to the federal Centers for Disease Control and Prevention, oil of lemon eucalyptus [active ingredient: p-menthane 3,8-diol (PMD)], tested against U.S. mosquitoes "provided protection similar to repellents with low concentrations of DEET." Oil of lemon eucalyptus should not be used on children younger than three years old.

Citronella is another natural product with limited repellence to mosquitoes.

Products come as lotions, pump sprays, and wipes. Which product is best? That's for you to decide. Look at the list of active ingredients and their concentrations to help decide which one to buy. *Always follow label directions when using repellents.*

Spraying mosquito larvae

Spraying to kill mosquito larvae can be very effective and has minimal environmental or toxicological risk **if the biological agent Bti is used**. *Bti* is shorthand for *Bacillus thuringiensis* variety *israelensis*, a natural bacterium that kills certain fly larvae but not other organisms.

Basically that means that *Bti* kills mosquito larvae (or black-fly larvae if used in streams) but doesn't harm fish, mammals, amphibians, reptiles, or other insects (including dragonflies, damselflies, water boatmen, caddisflies, mayflies, and stoneflies).

The mosquito *larvae* must feed on the *Bti* particles. Mosquitoes in their pupal or adult stages won't be killed when the stuff is sprayed into the water. Using *Bti* has several major drawbacks:

- It must be done before EEE cases appear—before we really know what the risk is going to be this year.
- It usually takes more than one treatment to control mosquito larvae for a long time.
- Treating water with pesticides in New Hampshire, even biological pesticides containing *Bti,* requires a special permit from the Pesticide Control Division of the State Department of Agriculture. Getting a permit takes time and effort. Most communities that plan mosquito abatement efforts send in their permit applications in January or February, to be certain that things are ready when work begins in the spring.

There are chemical-based larval control materials, but with *Bti* now available, we don't rely on them for mosquito control because they all kill many other organisms besides mosquito larvae.

Ideally, communities should tie a spraying program to a monitoring program that identifies where and when the human-biting or EEE-transmitting species are abundant. Spraying mosquitoes that aren't involved in disease transmission wastes time and money. But monitoring is expensive too, and requires special training that few New Hampshire pesticide applicators have.

Spraying adult mosquitoes

Spraying adult mosquitoes may help reduce the risk of being bitten, but it presents a number of problems.

The first is that if we aim to decrease the risk of acquiring EEE, we need to target the few mosquito species that can spread EEE. The vast majority of our 47 species of New Hampshire mosquitoes aren't involved. We could try to kill all mosquitoes, but that would be wasteful and expensive. Also, using chemical insecticides can carry environmental and toxicological risks.

Sampling and identifying larval or adult mosquitoes is a lot of work, requires special training and equipment, takes time, and can be expensive. There are relatively few trained personnel in New Hampshire.

Spraying to kill the adult mosquitoes usually requires specialized ultra-low-volume spray equipment (and special training), and is difficult or impossible in many areas. The effects last a few hours to a few days.

Most commonly, a truck-mounted (ultra low-volume) sprayer is used for adult mosquitoes. It usually sprays while driving down public roads or on firm surfaces like athletic fields. The spray drifts away from the vehicle and controls mosquitoes in a swath that might be only 30 to 100 yards wide. In rural areas, roads are few and far apart, so this spraying only hits a small area of the town. In more urban areas, roads are closer together, so a spray truck going down the roads can cover a higher percentage of the area. Spraying for adult mosquitoes is intended to protect people; you protect more people if you concentrate on areas of high human population or activity.

Sometimes hydraulic sprayers are used to treat vegetation in which mosquitoes rest. In this case, the treatment has a slightly longer effect, although it still lasts only a few days. This is one option if you wish to reduce mosquito problems for a single outdoor event. Sometimes backpack sprayers are used in less-accessible areas, especially for larval spraying.

If a threat from EEE materializes and adult mosquitoes are already flying, then careful treatment can reduce mosquito numbers for a short time. Mosquitoes can fly long distances, though, so they quickly re-invade the sprayed area from outside.

Chemicals used to control adult mosquitoes

The materials we have to control adult mosquitoes are all chemicals. The four most commonly used are all in the synthetic pyrethroid group: Bifenthrin, Permethrin, Resmethrin, and Sumithrin.

- **Bifenthrin** is a broad-spectrum insecticide, meaning that its kills many insect species in addition to your target species. Like many others, it is quite toxic to fish. It is photostable (sunlight doesn't break it down) and leaves an active residue for a fairly long time.
- **Permethrin** is a broad-spectrum insecticide. It is fairly persistent, and photostable. It is highly toxic to fish and honeybees, and is an ingredient in many backyard pesticide products.
- **Resmethrin** is also very toxic to honeybees and fish. It is less persistent than permethrin, and a little more easily broken down in sunlight.
- **Sumithrin** is similar to resmethrin in persistence and photostability.

Sometimes another chemical, **piperonyl butoxide**, is added to a pyrethroid insecticide. Piperonyl butoxide works as a *synergist*, which means that adding it greatly increases the effectiveness of the insecticide. It is quite short-lived.

These pesticides vary in their toxicity, persistence, and effectiveness. These characteristics (plus cost and availability) affect the decision of which product to use in a given situation

*****_The relative toxicity of pesticides is usually measured by a number called the **LD50**, the number of milligrams of test chemical required per kilogram of weight in a test animal to cause 50 percent of the test animals to die. **The lower the number, the more acutely toxic the material.** The LD50's given in the examples below are for skin exposure to rats and rabbits, which are used as estimators of human toxicity._

Pesticide	**LD50**
Bifenthrin	>2000
Permethrin	>4000
Resmethrin	2500
Sumithrin	>10,000
Piperonyl butoxide	7500

Public notice

Spraying public areas requires public notice in advance of treatment, and posting signs. Citizens not wishing to have their property sprayed can contact local officials.

Officials who plan to spray will also want to identify all beekeepers and certified organic farms in their towns. Honeybee colonies located too close to spray trucks might suffer high losses if they were directly sprayed. Application or drift of pesticides onto certified organic farms could void the farmers' certification, and take 3 years for them to get it back.

Details on public notice, posting, the permit procedures (and filing an emergency permit request, if necessary) are available from the Pesticide Control Division, N.H. Dept of Agriculture, Markets and Food, 603-271-3550.

Source reduction

Source reduction means reducing mosquito numbers by reducing the areas where their larvae can live. Reducing the habitat for mosquito larvae will result in fewer adult mosquitoes.

Predicting mosquito numbers months in advance is nearly impossible. If we have rainy conditions, rainwater will fill countless thousands of vernal pools, marshes, tree holes, and empty containers left outdoors. Because adult female mosquitoes can lay hundreds of eggs apiece, the population can explode during rainy seasons. In seasons with very little rain, the swamps, marshes, and containers dry up, reducing breeding sites and the subsequent numbers of adult mosquitoes.

When it comes to things like poorly adjusted gutters, old tires or other containers left out in the rain, creating breeding grounds for mosquitoes, source reduction is easy. But things become complicated when we consider natural water bodies such as marshes and other wetlands. If someone insists the vernal pools must be filled in because mosquitoes breed there, then we lose a lot more than mosquitoes:

- Wetlands play important roles in keeping streams and rivers flowing, and recharging groundwater.
- They may serve as vital sources of irrigation water for agriculture.
- Wetlands are important for wildlife; some of our threatened or endangered species must have wetlands, or face extinction. Spotted salamanders and wood frogs are two examples of New Hampshire species that **must** have vernal pools in which to breed.
- Management of ponds and wetlands is regulated by the N.H. Department of Environmental Services. If you want to drain or alter natural water bodies for mosquito control, you need to obtain a permit before any work can begin.

Reducing water-holding containers around the home (poorly adjusted gutters, bird baths, old tires, and other containers that fill with rain water) isn't a very effective tool for managing EEE, since very few mosquitoes that spread EEE breed in such habitats. One possible exception: *Ochlerotatus triseriatus*, a common tire breeder.

However, reducing water-holding containers around the home will definitely help reduce the risk of West Nile Virus, another mosquito-borne viral illness, caused by different mosquito species from those that cause EEE. (See below for more information on WNV.) Also, it can significantly reduce the nuisance of mosquito-biting around your home.

Introducing predators

Sometimes people want to control mosquitoes by introducing predators. Bats and many birds eat flying insects. Why not put up houses for bats or purple martins to solve the problem? Why not buy dragonfly nymphs? They're predators.

Although putting up houses for birds or bats theoretically might help, these techniques have never been demonstrated to reduce mosquito numbers. Bats and insectivorous birds eat whatever insects are abundant and the correct size for them.

Since catching insects on the wing takes lots of energy, they optimize feeding by going for bigger bites rather than staying with tidbits. If large flying insects—big moths and juicy beetles—abound, the hunters go for them.

Also, predators don't knock the population down far enough to suit humans. When mosquitoes start to get scarce, the predators that eat them must switch to other food to make a living. If we wanted predators to significantly reduce the risk of EEE, they would have to dramatically reduce the population **of the few mosquito species that are EEE vectors.** That isn't consistent with the way predators work.

If you wish to put up wildlife houses, do it for other reasons, but don't depend on bats and birds to solve mosquito problems.

As for dragonfly larvae, they theoretically might help, but any New Hampshire water body appropriate for dragonflies is already inhabited by dragonflies. That goes for other mosquito larvae predators. We don't need to import them, because they're already here.

Also, the dragonfly species appropriate for a particular body of water vary with water and vegetation type. We have roughly 100 species of dragonflies in southern New Hampshire. Who would know which species was which? Where would we go to get them? Finding a commercial source of the correct species might be very difficult.

Adult dragonflies are also active predators. They feed on flying insects, including mosquitoes. Like bats, they concentrate on whatever prey is abundant, rather than focusing on mosquitoes. Plus, nearly all dragonfly species are daytime flyers (two rare ones come out at dusk) while very few mosquitoes are daytime fliers. There is a short period each 24 hours (towards dusk) when dragonfly adults may encounter and eat significant quantities of mosquitoes. Dragonflies don't fly when it rains, and few fly in early morning—it takes a while for them to warm up for the day.

Dragonflies are among the predators we hope to conserve by avoiding unnecessary chemical pesticide use. *Bti*–based insecticides don't kill dragonflies.

Water gardens

Many people have created water gardens on their property using a large plastic or fiberglass liner as the water container. Introducing water plants into the container creates a mini-wetland right in your yard. Some insect predators eventually find their own way there. Examples include insects such as backswimmers and predaceous diving beetles.

If you have a water garden, please consider adding small fish from the start. Certain species of mosquito

will quickly find and breed in your garden. Many species of small fish eagerly eat mosquito larvae, so you may come out even.

Be sure you follow state laws and regulations for introducing fish into your water garden (or backyard pond). See salient information below, or contact the N.H. Department of Fish and Game (Inland Fisheries, 603-271-2501) for more information.

> **Importing and Releasing Wildlife (RSA 207:14)**
> No person shall import, possess, sell, exhibit, or release any live marine species or wildlife, or the eggs or progeny thereof, without first obtaining a permit from the N.H. Fish and Game Department's Executive Director.
>
> **Release of Fish (Fis 402.06)**
> (a) No live fish shall be released in any waters of the state unless they shall be returned into the waters from where taken except as permitted by the executive director under a permit to release.
> (b) No person shall have live fish in their possession when leaving the freshwaters of the state, except those species allowed to be possessed and used as live fish for bait or the person is participating in a permitted fishing tournament

Mosquito traps

Until recently, mosquito traps worked to collect some specimens and determine species present, but didn't **control** mosquitoes. Now things are somewhat less definitive. Among the brands of mosquito traps now available, some use carbon dioxide as their principal attractant, and others add octenol or other attractants. Some of these newer traps capture many times the number of mosquitoes as their predecessors, and may help reduce mosquito *annoyance.*

Results vary from site to site. Recent scientific reports have occasionally shown the traps reduced bite counts for certain mosquito species. As yet, no studies that concentrate on EEE vectors have appeared, so we really don't know how effective the traps are at reducing the risk of getting EEE. Mosquito traps on the market can be very expensive. You can buy many years' worth of repellent for the cost of one trap.

Electric bug "zappers" are commonly sold, and some promotional literature claims they kill mosquitoes. While these devices may "zap" the occasional mosquito, they don't reduce mosquito *problems*. However, the zappers do kill a large number of harmless insects and many beneficial insects. The ultraviolet light attracts beetles, flies, moths, caddisflies and many other insects, but few pests.

Ultrasonic mosquito repellers similarly have no effect in reducing mosquito problems, and their claims of effectiveness are misleading or false.

Mosquito mobility: a problem in control

A problem in spraying adults, treating larvae, and source reduction is that adult mosquitoes are highly mobile. Some of them live a long time, and can fly quite far from the place where they emerged. Most people who want to "eliminate" mosquitoes by spraying or source reduction will find that much of the mosquito problem comes from neighboring sites as far as a mile away. But that's often why information campaigns try to get as many people as possible to help. When everyone pulls together, the problems can be reduced.

High mobility is another reason larval treatments need to be repeated after a while. New adults fly in and lay their eggs continuously over the summer.

Monitoring the risk of EEE

State and local public health officials monitor EEE and West Nile virus indicators. Monitoring efforts include:

- Trapping and testing adult mosquitoes.
- Testing sick animals and people.
- Monitoring mosquito larvae (numbers and species).

Testing dead birds for EEE began in 2005. It was intended to give us early warning about EEE (and West Nile Virus) risk. Crows, jays and ravens were of greatest interest, since that family of birds (corvids) is very susceptible to the diseases. In 2008, the N.H. Department of Health and Human Services reduced its bird testing program. Analysis of the effort indicated that it wasn't very useful to give advance warning of human EEE risk, and it was very expensive. Under certain situations, the department may do some limited testing, but soliciting information on and testing dead wild birds is unlikely to resume.

Mosquito testing is expensive, so officials have focused their efforts in the southeast, where the risk is greatest and human populations are high. The traps they use are designed to attract egg-laying or biting mosquitoes and keep the trapped insects in good enough physical condition that they can be identified.

The freshly trapped and identified mosquitoes are placed in groups ("pools") and analyzed by the state labs in groups, to reduce costs. These data tell us when the virus is circulating at significant levels in the mosquito population. Formerly, the term "pools" confused many people, who thought it referred to a pool of water. This year, testing reports will refer to mosquito "groups."

Some communities (Dover, Portsmouth and Keene among them) conduct surveys of catch-basin mosquitoes in storm-drain systems.

The N.H. Department of Health and Human Services maintains a Web site that displays monitoring results of this and previous years. The maps are particularly good at quickly conveying the locations of testing, and positive results. A link to this Web site is at the end of this paper, under Information Sources.

West Nile Virus

West Nile (WNV) is another bird disease also spread by mosquitoes. But the mosquito species that transmit WNV differ from those that spread EEE. WNV was first recognized in North America in the summer of 1999.

The risk of catching it is very low in New Hampshire, and the infections are usually mild. As with EEE, those most likely to have serious WNV symptoms are older and very young people. Most people who come down with WNV have symptoms so mild they don't visit a physician, and never know they were infected.

Nationwide, the pattern of WNV has dramatically shifted. Most cases now are in western states. As of December, the CDC reported nearly 1400 human WNV cases in 2008. Maine, New Hampshire and Vermont had no human cases. California had more than 400. A link to CDC's Web site and data is at the end of this paper, under Information Sources.

Peridomestic mosquitoes (species that breed around buildings, homes, human habitats) are strongly implicated in the risk of acquiring WNV, and attention to source reduction around buildings and yards

can significantly reduce the risk. This means regularly emptying things that can fill with rainwater (and breed mosquitoes), or placing them under cover, so they don't fill. Water gardens, poorly adjusted gutters, discarded tires, pool covers, and rain barrels are examples of sites that can support high numbers of mosquito larvae. Possible vector species include Culex pipiens, Culex restuans and several others.

Effects of WNV and EEE on wild bird numbers

Our native birds have co-existed with EEE for thousands of years, plenty of time for them to adapt. Although infected birds may get sick, either the birds don't die or the death rate is too low for us to see changes in bird populations.

West Nile virus is different. It wasn't discovered (probably didn't exist) in North America until 1999, so we are still learning how it interacts with North American wildlife species. Crows and their relatives (jays, ravens) are quite susceptible, and dead WNV-infected crows have been found in many states.

Several bird survey indicators showed a drop in crow numbers after WNV appeared in North America. One local example was the Audubon Society of New Hampshire's backyard winter bird survey. In 2005, American crow numbers decreased to the lowest level in 18 years. Since then, numbers have recovered somewhat. Blue jay numbers also declined in 2004 and 2005, but have recovered. The blue jay population is affected by the abundance of each year's acorn crops, so a decrease could just reflect a poor acorn crop. Data from the North American Breeding Bird Survey also suggests there might be a drop in crow numbers in the Northeast since WNV appeared.

Managing and communicating risk

Managing risk from these diseases can be very complicated. Most people don't understand the technical details and scientists themselves still have many gaps in their knowledge.

Whatever public officials do—or don't do—may provoke strong public response. For example, when officials distribute literature informing residents about ways to protect themselves and their family members from mosquito bites, some people just don't regard this as worthwhile or effective. To some people, the sight, noise or smell of a truck passing by spraying insecticide provides the real assurance that "something is being done."

Peter Sandman, a longtime professor of risk communication at Rutgers University, offers public officials these 25 guidelines for good risk communication:

- Don't over-reassure.
- Put reassuring information in subordinate clauses.
- Err on the alarming side.
- Acknowledge uncertainty.
- Share dilemmas.
- Acknowledge opinion diversity.
- Be willing to speculate.
- Don't overdiagnose or overplan for panic.
- Don't aim for zero fear.
- Don't forget emotions other than fear.
- Don't ridicule the public's emotions.
- Legitimize people's fears.

- Tolerate early over-reactions.
- Establish your own humanity.
- Tell people what to expect.
- Offer people things to do.
- Let people choose their own actions.
- Ask more of people.
- Acknowledge errors, deficiencies, and misbehaviors.
- Apologize often for errors, deficiencies, and misbehaviors.
- Be explicit about "anchoring frames."
- Be explicit about changes in official opinion, prediction, or policy.
- Don't lie, and don't tell half-truths.
- Aim for total candor and transparency.
- Be careful with risk comparisons.

For more information, please read **Fear of Fear: The Role of Fear in Preparedness ... and Why It Terrifies Officials** http://www.psandman.com/col/fear.htm. For a complete series of crisis communication materials by Sandman and his wife Jody Lanard, a medical doctor, visit their Web site http://www.psandman.com/handouts/AIHA-DVD.htm

Integrated pest management

Rather than rely mostly (or only) on pesticides to manage the risk that humans and equines will catch EEE, we recommend an integrated approach that combines several methods. Integrated pest management (IPM) against EEE would combine use of repellents, behavior modification (clothing, time and place of activity, etc), source reduction, and monitoring the appearance and spread (that's for officials to do) of mosquito populations. Officials might also consider a role for larvicides and/or adulticides. Of course, this strategy also implies a network of good medical care for those who become ill.

Using multiple tactics that complement each other strengthens the overall effectiveness of a program and reduces the risk that the mosquitoes will develop resistance to pesticides or otherwise circumvent our management efforts.

An IPM campaign requires residents themselves to become informed about EEE and shoulder some of the burden of reducing risk by using repellents, dressing to minimize exposed skin and limiting outdoor activity during periods when EEE-carrying mosquitoes are active (around dusk and dawn, especially in late August and September).

EEE in domestic animals

EEE is serious and usually fatal in equines (horses and their relatives). A vaccine is available that gives them almost complete protection, but the vaccine is only approved for use in equine species. Even when mosquitoes bite them, infected equines can't pass EEE on to other animals, because their blood doesn't carry a high enough concentration of virus.

Animals can adapt to diseases over many generations, so species native to North America are more likely to tolerate infection, while exotic species are more likely to be susceptible. Llamas and alpacas, native to South America, are vulnerable, and there is no vaccine for them. Emus, native to Australia, are also very susceptible, and there is no licensed vaccine for them either.

Cloven-hoofed livestock (such as cattle, pigs, elk) may be susceptible, but their level of risk is unknown. Some states have discovered whitetail deer infected with EEE, but no one has studied just how serious those infections are. Deer have been here for thousands of years, plenty of time to adapt to the virus.

Birds are vulnerable, including domestic species, though they vary in their susceptibility and in the level of virus that develops in their blood when they get the disease. Ring-necked pheasant is one species that develops a high level of virus in the blood upon infection. This means sick pheasants can serve as a source of virus for mosquitoes to spread the disease further.

During the 1974 EEE outbreak, then-Governor Meldrim Thompson ordered the killing of several thousand ring-necked pheasants being reared by the N.H. Department of Fish & Game. He was concerned that the pheasants could help spread the disease. Ring-necked pheasant is not native to the U.S., so it hasn't had much time to adapt to this disease.

Training in mosquito identification

Learning to distinguish the species of mosquitoes found here (both adults and larvae) is important for anyone attempting to conduct monitoring programs. Texts and keys are available, but self-study can be difficult for people not trained in insect identification and taxonomy. Dr. John Burger of the UNH Department of Biological Sciences offers one-to-two-day mosquito identification training. Contact Dr. Burger at (603) 862-1736 or jfb@cisunix.unh.edu for information about the training.

Information Sources

- **Centers for Disease Control and Prevention Eastern Equine Encephalitis fact sheet**
  http://www.cdc.gov/ncidod/dvbid/arbor/eeefact.htm
- **Centers for Disease Control and Prevention West Nile Virus fact sheet**
  http://www.cdc.gov/ncidod/dvbid/westnile/
- **New Hampshire Department of Health and Human Services Fact sheets on EEE and WNV**
  http://www.dhhs.state.nh.us/DHHS/CDCS/West+Nile+Virus/default.htm
- **New Hampshire Department of Health and Human Services Arbovirus testing results**
  http://www.dhhs.state.nh.us/DHHS/CDCS/West+Nile+Virus/arboviral-test.htm
- **New Hampshire Division of Health and Human Services Hotline** 1-866-273-6453. The hotline is dedicated to EEE/WNV between June 1 and October 31. The rest of the year it becomes the state's dedicated flu (or other emergency) hotline. Callers interested in EEE or WNV information between November and June can ask to speak with the arboviral disease coordinator.
- **Guidance for Towns and Cities: Response Plans and Funding for Mosquito Control**
  http://www.dhhs.state.nh.us/DHHS/CDCS/West+Nile+Virus/wnv-eee-towns.htm
- **New Hampshire Department of Agriculture, Markets & Food**

  Pesticide Control Division
  http://agriculture.nh.gov/divisions/pesticide_control/index.htm Information on pesti cide applicator licensing, permits to apply pesticides to water, and emergency permit requests: 271-3550
  Division of Animal Industry
  http://agriculture.nh.gov/divisions/animal_industry/index.htm Information relating to animal health in New Hampshire: 271-2404

Division of Regulatory Services
271-3685. List of certified organic growers in N.H. http://agriculture.nh.gov/divisions/markets/index.htm

- **University of New Hampshire Cooperative Extension Family, Home & Garden Information Center Info Line: 1-877-398-4769**, Monday-Friday, 9:00 am - 2 pm and Wednesday evenings 5 - 7:30 (toll free in N.H.) Info center staff can answer questions or direct callers to expert resources.
- **Dr. Alan Eaton, Extension Specialist, Entomology.** University of New Hampshire Cooperative Extension, Durham. (603) 862-1734
- **Audubon Society of New Hampshire** (winter bird counts, other survey information) http://www.newhampshireaudubon.org/conservation_projects.php#section1

Spraying and/or Monitoring Services*

Dragon Mosquito Control, Inc. (Monitoring and control services) (603) 964-8400, PO Box 46, Stratham, NH 03885. Email: dragonmosquito@comcast.net

Municipal Pest Management Services, Inc. (Monitoring and control services) (603) 431-0008 PO Box 316, York, ME 03909. Email: swampfixer@myfairpoint.net

Atlantic Pest Solutions (Monitoring and control services) (800) 439-7716 PO Box 547, Epping, NH 03042. Website: www.GOatlanticgreen.com

ARBORPro Plant Care Experts (Spray service, both private property and municipal spraying) (603) 332-9277, 10 Lyons Street, Rochester, NH 03867. Email: sales@arborproexperts.com

Collins Tree Service (Spray for events & functions) (603) 485-4761 or (603) 746-4868 PO Box 16388, Hooksett, NH 03106.

EcoTech (Mosquito spraying on private properties on seacoast, not municipal work.) (207) 451-9451 PO Box 54, Eliot, ME 03903.

J P Pest Services (Spraying municipal, residential & commercial property) (800) 222-2908, 101 Emerson Road, Milford, NH 03055. Email: mattf@jppestservices.com Website: www.jpmosquitocontrol.com

Knowles Grounds Maintenance (backpack spraying of residences) (603) 964-1491, 16A Woodknoll Drive, North Hampton, NH 03862. Email: knowlzee@comcast.net

We've attempted to include all companies licensed in mosquito monitoring or control in New Hampshire that wanted to be listed. Inclusion in the list implies no endorsement by UNH Cooperative Extension, nor does exclusion from the list imply any lack of confidence in a company's services. The list of licensed companies changes, so other companies might have appeared since this revision, done Jan/Feb 2009.

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Fact sheet by Alan T. Eaton, PhD, UNH Cooperative Extension Entomology Specialist